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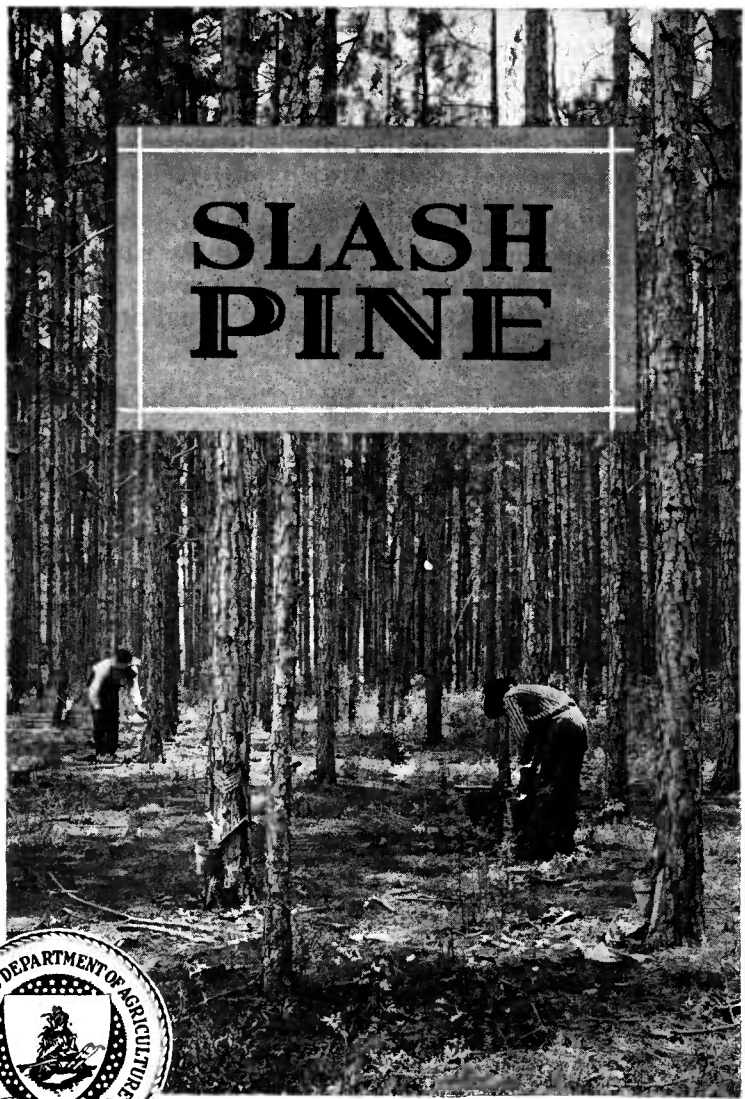

SLASH PINE grows rapidly and yields revenue in turpentine gum at an early age while it is growing timber.

Farmers and other owners of cut-over pine lands in the South Atlantic and Gulf regions are deriving a good profit from poorly drained and other lands by utilizing them for the production of turpentine and timber as well as the grazing of livestock.

Well-stocked stands of slash pine produce timber for ordinary purposes in 30 years, at the rate of 100 to 250 board feet an acre a year on average poor-quality land, and on average good situations at the rate of 300 to 500 board feet yearly.

Slash pine can be profitably grown in the South on poor and wet lands.

There are millions of acres in unimproved parts of farms and in cut-over lands that are profitless for agriculture, but suitable for the production of timber and naval stores.

By proper methods of cutting and protection, southern pine forests can be perpetually renewed and kept continuously productive.

Young pine is valuable.

The picture on the title page is second-growth slash pine in southern Georgia being worked for turpentine.

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SLASH PINE

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CONTENTS

SLASH PINE—A DUAL CROP

SLASH PINE, a native of the South Atlantic and the Gulf region, is one of the most profitable forest trees in the United States.[1] In its own range it is being extensively cared for and planted as an orchard because of its rapid growth and high value for the production of naval stores, pulpwood, and lumber.

Second-growth slash pine, following the cutting of the original forest, has spread rapidly over large areas of flatlands and low uplands of the region. It has been particularly aggressive in establishing itself on old fields and other idle or waste lands about farms and towns. Not less than 80 per cent, it is estimated, of the total amount of sap pine cut for pulpwood and crossties in southern Georgia and northern Florida is slash pine. Timber from original growth trees is used or sold without discrimination along with longleaf pine.

The heartwood of slash pine is the heaviest, hardest, and strongest of all pines of the United States. The yield of crude turpentine from slash pine is the largest from any of our native trees. In the economic development now well under way in the South, slash pine is playing a large part in bringing nonagricultural lands into their most profitable use.

A caution in managing slash pine lands can not be too strongly emphasized. The custom of turpentining small trees before they reach the age of profitable working and ample seed production calls

[1] The botanical name is *Pinus caribaea* Morelet. Formerly in forestry literature the tree was called Cuban pine.

The right use of the turpentine hack and later the ax and saw, and the protection of the land at all times from fire are the keys to the problem of growing slash pine profitably as a crop.

for special attention in management. There should in all cases be an abundance of seed just before making the final cutting of the

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FIGURE 1.—A young generation of slash trees about 14 years old is shown with their mother tree. Light orange-colored scales or plates of bark serve to distinguish mature slash pines from all other trees

timber crop so as to provide for the renewal of the stand as the necessary basis for another timber crop on the land.

How can you tell slash from other pines?

Because of the general resemblance of young slash pine to vigorous loblolly pine, and of the mature slash pine to longleaf pine, considerable difficulty is experienced by persons unfamiliar with the southern pine forest in differentiating the species. However, slash pine is not difficult to identify if one possesses the essential information regarding the leaves, cones (burs), bark, and winter bud.

The bark is fairly similar to that of longleaf pine. (Fig. 1.) It differs from that of loblolly pine by being less deeply furrowed. Old mature slash pine may be readily told by its orange-colored bark plates or scales.

The leaves grow in clusters of two or three, usually with more of the 2-leaved clusters. They are mostly 8 to 12 inches long, and bright, glossy rich green. (Fig. 2.) The heavy, shiny green foliage helps greatly in distinguishing slash pine from the associated longleaf pine with its coarser and rather bluish-green foliage. Loblolly pine, like longleaf pine, has three bluish-green leaves in a cluster, but has much smaller leaves than longleaf or slash.

The cones are egg shaped and average 3 to 4 inches in length and when closed, are about 2 inches in width. (Fig. 2.) A prickle is borne on the lustrous or varnished brown end of the cone scale.

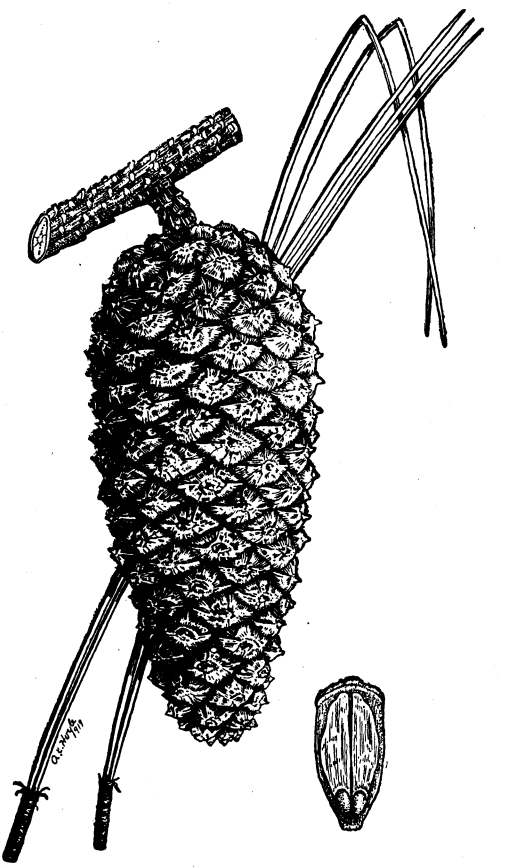

FIGURE 2.—Cone or "bur," 2-leaf clusters, and a cone scale of slash pine. The ends of the cone scales are plump, rounded, lustrous brown, and bear a small prickle. At the base of each scale two seeds are borne, each with an ample wing for wide dispersal. Leaf bundles of slash pine contain either two leaves or three leaves in a cluster

The terminal bud is large, reddish brown in color, and in the spring elongates into a straight, stout, light-gray "candle," about the thickness of a large pencil. Longleaf pine, in distinction, has a similar but larger bud elongating into a light-gray candle, an inch or more in diameter.

The main characteristics by which slash pine may be identified are the 2-leaf or 3-leaf clusters of long, dark-green leaves; the slender prickle on the cone, pointing straight or slightly curved upward on the lustrous-brown scale of the fresh mature cone; and the early

spring candle or shoot, which is light gray, erect, and about one-half inch in diameter.[2]

Mature trees of slash pine rise to heights of 80 to 125 feet, with clear lengths of 40 to 70 feet. Diameters of trunks range from 2 to 3 feet, measured at breast height, or 4½ feet from the ground.[3] Old-growth trees at maturity are mostly from 100 to 200 years old.

WHERE SLASH PINES GROW

The natural range of slash pine extends from about Charleston, S. C., westward through the lower parts of Georgia, Alabama, Mississippi, and southeastern Louisiana to the Mississippi River. (Fig.

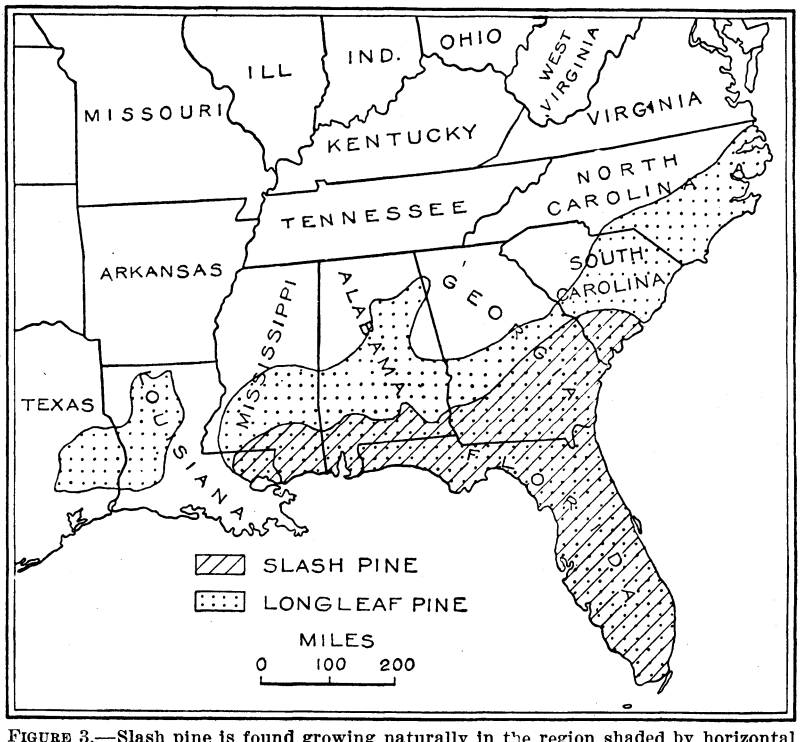

FIGURE 3.—Slash pine is found growing naturally in the region shaded by horizontal lines. Longleaf pine is found in the region indicated by scattered dots. Both kinds of pine thus occur in the slash pine belt

3.) Large areas of slash are in Georgia and in Florida, where the tree grows nearly to the end of the peninsula. Slash pine is commercially important over its whole range.

In the original forest slash pine was confined mostly to the poorly drained flat lands and borders of swamps and bodies of fresh water. With the subsequent extensive cutting slash pine became released in much the same way as loblolly pine was farther north, and it is now

[2] The spring shoot of loblolly is grayish green, slender, and often curved or drooping instead of erect.

[3] Unless otherwise stated, all diameters referred to throughout this bulletin are based on measurements at breast height.

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FIGURE 4.—Thrifty slash pine trees 22 years old. The smaller trees can profitably be worked and cut out, leaving the larger trees to grow a crop of saw timber

spreading widely over lands formerly dominated by longleaf pine. (Fig. 4.) It is found on many different kinds of land, but not on dry

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FIGURE 5.—The very dense or heavy wood of the slash pine, formed even during its early years, is a good characteristic of the tree. The 17-year-old tree shown in the section produced wood consisting of 63 per cent of dense summer wood, leaving only 37 per cent of soft spring wood

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FIGURE 6.—The use of southern pine for paper pulpwood is rapidly increasing. The pulp mills buy round or split wood from 3 to 12 inches in diameter. Apparently there will be a much larger demand than at present for slash and other pines for making paper

deep, sandy ridges. On wire grass and palmetto flats it is often the only second-growth species of pine. Slash pine thrives extensively

over the low, rolling or hilly lands of southeastern Georgia, in sandy loam soils in poorly drained situations, and in the wet, mucky soils of bays, ponds, and swamps. It will tolerate a highly acid condition in the surface soil, and a calcareous substratum does not appear to be unfavorable to its growth. On soils with hardpan at shallow depths the tree appears to be somewhat dwarfed in size. It is absent from the very dry, deep sands of the "pine-barren" hills, such as are found in parts of western Florida and southern Mississippi; but even in those sections it is locally abundant on wet flats and close to lakes and streams and in the numerous ponds scattered all over the coastal plain. By means of planting the range of slash pine is being considerably extended.

THE WOOD AND ITS USES

Slash pine heartwood is the heaviest, hardest, strongest wood of all the commercial conifers in the United States.[4] The weight of

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FIGURE 7.—Slash pine trees grow in close or dense stands and are cut in great numbers for telephone and power-line poles. After being treated with creosote they can be used for 20 to 40 years

the air-dry heartwood averages 45 pounds per cubic foot. In the butt cut the wood averages about 55 per cent of dense bands of summer wood, while farther up the tree the proportion of summer wood decreases, at the top of the second cut to about 40 per cent. (Fig. 5.)

What are the chief uses of the wood?

The lumber from mature slash pine is used for structural purposes and is in demand for bridges, trestles, docks, warehouses, and fac-

[4] According to results of tests made at the Forest Products Laboratory, U. S. Forest Service, in cooperation with the University of Wisconsin, Madison, Wis., the wood of slash pine averages a little heavier, harder, and stronger than that of longleaf.

tories, in which it is employed for dimension timbers, posts, piles, and joists. On account of its strength and stiffness, it is used for railroad cars, and its hardness and wearing qualities make it suitable for flooring. It is extensively used for veneers for boxes and other packages, and as boards for slash cooperage.

Second-growth or "sap" slash pines after being turpentined are extensively cut for use as crossties and pulpwood.

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FIGURE 8.—The adaptability of slash pine to heavy wet soils enables it to grow rapidly even in dense stands, thus producing a large amount of timber in a relatively short period

The wood of slash pine is well adapted for making paper pulp, and the mills accept it (fig. 6) readily along with that of other kinds of pine. The wood is manufactured into "kraft" paper, which is the extensively used brown or wrapping paper, and which is made in various thicknesses and shades of color. The paper industry is

expanding rapidly throughout the pine region of the South. Analysis has shown a low percentage of resin in sapwood of cut trees. Slash pine is also used extensively for fuel. Because slash pine occurs in dense stands of straight clean trees, it is one of the choicest timbers for poles and piling, for which use it is cut in large quantity and brings good prices. (Fig. 7.)

GROWTH OF TREES

Slash pine is one of the most rapid growing and earliest maturing of all our forest trees. Growth in height and in diameter is especially rapid during the younger stages up to about 20 years of age. One-year-old seedlings commonly reach 8 to 12 inches in height. At 5 years, slash pines range mostly from 8 to 12 feet in height. During the next 5 to 10 years an upward growth of 2 to 3 feet yearly is not uncommon. When about 20 to 25 years of age the rate of upward growth of slash pine slackens, apparently being about the same as that of longleaf on situations of similar grade. In crowded stands (fig. 8) the increase in diameter is slower than that of trees growing a considerable distance apart. Table 1 shows for different ages the average heights and diameters of slash pine trees and the number of trees per acre found in well-stocked stands. The range in size at any given age varies chiefly with the favorableness of the soil or situation, and with the tree density, or number of trees per unit area.

TABLE 1.—*Average size of slash-pine trees at different ages grown in open and in close stands on different grades of soil; also average number of trees per acre*

Age of trees, years	Height of trees on—			Diameter of trees (breast height)						Number of trees per acre in fully stocked timber stands [1]
				Open-grown stands on—			Close-grown stands on—			
	Good land	Average land	Poor land	Good land	Average land	Poor land	Good land	Average land	Poor land	
	Feet	*Feet*	*Feet*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	
15	48	39	29	8.8	6.9	5.2	6.6	5.2	3.9	55
20	61	48	36	10.3	8.0	5.9	7.7	6.0	4.4	150
25	71	56	42	12.3	9.6	7.1	9.2	7.2	5.3	265
30	79	63	48	13.7	10.8	7.9	10.5	8.3	6.1	300
35	86	69	52	15.2	12.0	9.0	11.7	9.2	6.9	305
40	92	73	55	16.6	13.1	9.9	12.8	10.1	7.6	295
45	96	77	58	17.1	13.5	10.1	13.7	10.8	8.1	280
50	100	80	60	18.1	14.2	10.7	14.5	11.4	8.6	260
55	103	83	62	18.8	14.8	11.0	15.0	11.8	9.0	245
60	106	85	64	19.4	15.2	11.6	15.5	12.2	9.3	230

[1] All trees 7 inches and over in diameter outside bark at breast height. The trees on the better qualities of land are fewer and larger in diameter; the number on the poorer lands is greater and the trees are smaller in diameter.

How fast do slash pine trees grow?

For example, as shown in Table 1,[5] at 15 years of age the trees in well-spaced stands range in height from 29 up to 48 feet, and in open-grown stands (columns 5, 6, and 7) in diameter from about

[5] The tables of growth, volume, and yield of timber and much of the information on good turpentine practices are based upon the results of studies carried on by the southern forest experiment station of the U. S. Forest Service, located at New Orleans, La.

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FIGURE 9.—Example of fastest growth of slash pine resulting from continuous fire protection. The trees in this 17-year-old unburned stand measured mostly from 8 to 13 inches in diameter and 50 to 65 feet tall. The average tree was 10.7 inches in diameter (breast height) by 61 feet tall. In the 17 years this open-grown stand had produced 12,600 board feet of lumber. The thick mat of pine leaves or straw, plainly seen in the picture, affords favorable soil protection against extremes of heat and moisture

5 to more than 8½ inches. If, however, the trees have grown closely with less space for development, it is not uncommon to find them from about 4 to 6½ inches in diameter at breast height, as shown in columns 8, 9, and 10. At 30 years slash pine stands usually consist of trees ranging from 48 to 79 feet in height, and in diameter in open stands from 8 to 13½ inches, or in crowded stands from 6 to 10½ inches. Crowded stands 30 years old may have about 300 trees per acre that measure 7 inches and more in diameter. Open, or better-spaced stands for turpentining may have from 150 to 200 trees per acre.

The sizes of trees growing in good grade of soil are shown in the columns headed "Good land." The class "Poor land" includes very wet or highly acid soils, on which, however, slash pines often seed freely, but the trees make only slow growth and reach relatively small sizes at maturity. The "Average land" class applies to the great bulk of lands on which slash pine is found growing.

An open stand growing in an old field in northeast Florida is shown in Figure 9, where the average tree of the 17-year-old stand was nearly 11 inches in diameter and 61 feet tall. Fire protection had been afforded throughout the life of the stand, which undoubtedly accounts for the large size and thriftiness of the trees and the maximum timber yield of the stand. Such open-grown or orchard-like stands favor the early production of turpentine and merchantable saw logs, but sacrifice a larger production per acre at a later date. However, moderately open-grown stands should be favored over too dense stands.

Do tree trunks lengthen?

Yes, but only by new growth at the top. Once the side limbs are formed, or set, they remain in that same position throughout the life of the tree, or until they die and drop off. All limbs or branches from the main trunk reach to the heart or center of the tree.

THINNING PINE STANDS

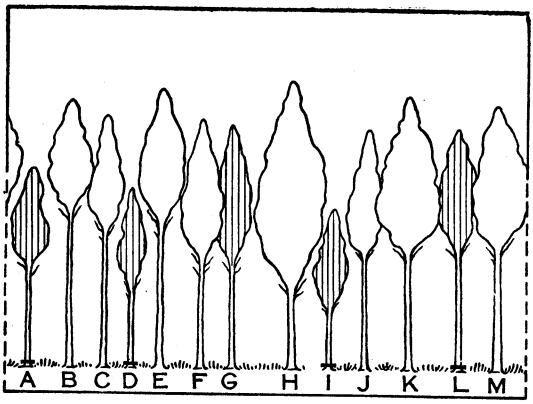
What effect does thinning have upon growth?

As in a stand of corn or cotton, the trees in a full pine stand crowd upon each other, and the stronger trees gradually crowd out the weaker. Too few trees on an acre result in bushy tops and knotty lumber; too many trees mean a slowing up of individual growth. There is a right number, varying with the age and location, to obtain the best growth of the largest number of trees. Thinnings are made when necessary to reduce the number of trees so as to obtain the maximum growth for the kind of product desired.

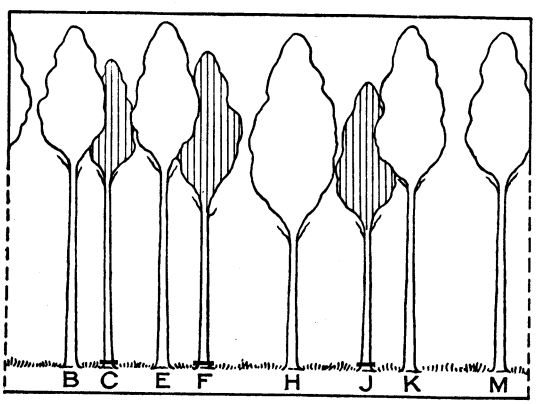
How should thinnings be made?

There are two ways of thinning pine stands. The whole subject of thinning slash pine stands is closely related to the working of trees for turpentine.

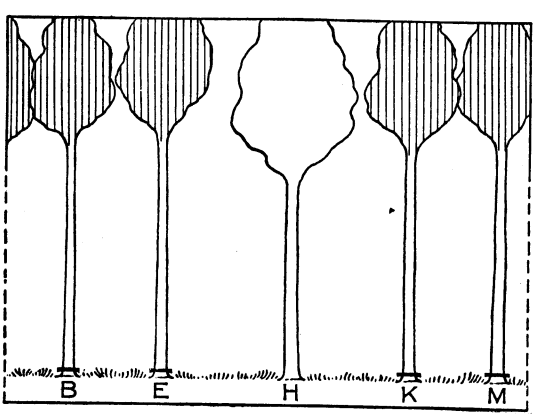
A so-called "low" thinning, as shown graphically in Figure 10, consists of cutting out the smaller, less vigorous, diseased, and unpromising trees. They may be worked first, but only if profitable. This method favors the largest and best trees and more nearly keeps the timber production at its capacity. Size and quality count much in the value of the timber.



Thinning.—Age of the trees, 5 to 10 years. A light thinning is to be made by cutting out the smaller, slower-growing trees, A, D, G, I, and L. This will still keep the bigger trees slightly crowded to force them to grow upward instead of growing outward and becoming bushy



Thinning.—Age of trees, 15 to 20 years. Another thinning is to be made now of the smaller, less vigorous and less promising trees, C, F, and J



Final cutting.—Age 30 to 40 years. The final cutting is made of all trees except one, H, a vigorous, bushy-topped tree, which is left to produce seed and restock the land. About three such trees are left growing on each acre until the land is well reset with young trees

FIGURE 10.—A good method of working, thinning, and later cutting the final crop of pine trees where turpentine and timber products are desired at intervals. The smaller, less vigorous, and defective trees of this even-aged stand are worked and cut out, giving space for the stronger-growing trees to grow. This is repeated a few years later. The cuttings produce fuel wood, crossties, small saw logs, or pulpwood. The final cut produces saw timber or piling of good size, good grade, and good value. The trees to be cut are shaded. The letters aid in identifying the trees

The first principle is to wait until the trees to be removed have reached a merchantable size, so that the thinning may at least pay for itself, or, better still, make a profit. The material removed may be used for firewood, pulpwood, excelsior wood, or small saw timber. An idea of the number of trees per acre in full timber stands at different ages can be obtained from the last column of Table 1. For best production of turpentine these numbers should be reduced one-half to two-thirds. Closely related to this subject is the plan of thinning and turpentining found on page 22, which should be considered along with this discussion. (Fig. 11.)

In a so-called "high" thinning, the larger trees are worked and cut, thus giving space for the smaller trees to expand. It is not an

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FIGURE 11.—The thinning and pruning shown here was done when the trees were too young, and was too heavy, resulting in greatly checked growth. For turpentine yields pruning side branches is bad practice. During slack time in one winter this farmer thinned 86 acres of dense sapling slash pines, from a stand of about 2,000 to 900 per acre. He then pruned off the lower branches, giving a clear trunk for about 7 feet. Pruning side branches favors clear trunks, desirable for poles, piling, and saw logs

uncommon practice of owners to work and cut the largest trees, because they are the first to become merchantable. What happens then is the recovery of the formerly stunted trees to a normal growth. This adjustment usually requires a number of years, during which there is a loss in the growing power of the land. Thinning by this method (of cutting out the largest trees) permits of a periodical money return every 10 years or so, a feature which appeals strongly to the farmer or other owner of timberland and is especially desirable when adapted to cutting timber, without turpentining it, for pulpwood, fuel wood, or other small-sized product.

TURPENTINING SLASH PINE

The growing of slash pine as a farm crop or, on a larger scale, as a commercial industry centers largely about its capacity for producing naval stores as well as sap pine wood.

For every dollar of profit made from the wood of slash pine there is likely a return of about $2 from the gum or crude turpentine. A too common practice has been to work slash pine trees as soon as they reached diameters from 6 to 8 inches, and after three to four years of working to abandon the stand. Usually the trees soon became greatly injured by fire, and in this manner second-growth slash trees have been extensively destroyed.

With the increase in the value of pine, modern practices of turpentining are improving. However, much pine timber is still being worked too small and too young, and chipping is generally made too deep into the tree and too wide up the tree. To keep pace with the keen competition that exists in the naval-stores industry the successful turpentine man needs to use methods that will give him the greatest possible gum yields, keep down the costs, and maintain the vigor of his trees. The growing scarcity of turpentine timber is causing timber owners to lease only to careful operators.

What are gum and naval stores?

When the sapwood of pine trees is wounded or chipped it "bleeds" a thick sticky liquid known as gum resin or crude turpentine. The gum is not, as often supposed, the sap of the tree. It is not drained from a store in the tree but is formed in small cells or ducts scattered in the sapwood. When cut or wounded, these increase greatly in activity in order to heal over the wound. The heartwood is dead, and if cut does not produce gum although it contains considerable hard resin.

It is well known in the South that this gum when heated in a still gives off a volatile liquid called spirits of turpentine, leaving a heavier thick residue which, upon cooling, solidifies to form rosin. In the days of wooden ships, these and other products, known as naval stores, were made and extensively used in calking and waterproofing the hulls as well as tarring the ropes.

How does slash pine rank in gum production?

Slash pine excels all other native pines in the quantity of gum resin or crude turpentine which flows from the trees when faced or worked.

Its gum when freshly exuded is clear and about the color of light-yellow honey. As compared with longleaf or "hill" yellow pine, its nearest competitor, slash pine yields from its gum and "scrape" a slightly higher percentage of spirits of turpentine and a higher grade of rosin. Beginning to run a little later in the spring than longleaf, probably because of the colder situation in low ground, slash pine keeps up a heavy flow until late in the season, considerably past the time when longleaf stops flowing; also in contrast to longleaf it produces only a little scrape. It is not uncommon to hear it said that slash pine is more likely to die from turpentining than is its associate, longleaf pine. Observations make it seem

probable that the basis for this statement is the capacity of slash pine for free production of crude gum.

What are some good practices in turpentining?

Practices that are generally recognized to be advisable as a means of getting the most revenue out of timber, consistent with conditions of labor and market, include the following:

(1) Work no trees under 9 inches in diameter (at breast height measured outside the bark). Trees to be removed in thinning young stands may be considered as exceptions to this rule.

Only small yields, with rarely any profit, are obtained from trees less than 9 inches in diameter. Beginning with a 9-inch tree, and working one low face at a time insures a high sustained yield over a

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FIGURE 12.—Good turpentining is shown. Only the larger trees, 10 inches or over, are being worked, with only one face per tree, and in two years the faces are only 32 inches in height. The cups were raised for the second year's working

period of years and the largest profit in the long run to both owner and operator. (Fig. 12.)

(2) Work only one face on trees from 9 to 15 inches in diameter, and never more than two faces on any tree.

(3) Advance streaks should be made preferably four to six weeks, and never less than two weeks, ahead of the regular chipping season.

(4) Use the cup method. Under no condition use the old and wasteful "box" method. Careful hanging of cups and aprons or gutters prevents waste. Do not slab off the bark at the base of the tree.

(5) Use a No. 0 hack, as this permits cutting streaks three-fourths inch deep and one-half inch up the tree, known as medium-light chipping. Conservative methods are more profitable than heavy workings for turpentine, which "dry-face" and destroy much timber.

Low chipping, one-fourth inch in width, gives more gum than medium (one-half inch) or high (three-fourths inch) chipping over a period of three years or more. If timber is to be worked for only two or three years and then cut, a high chipping is more profitable. Low chipping is adapted for owners wishing to operate their timber continuously over a long period of years.

The depth of chipping (ranging from one-third to 1 inch) in slash pine shows but little difference in the yield of gum; but a great difference in the condition of the tree at the end of four or five years. Deep chipping, or over one-half inch, causes dry faces and injury to the wood near the faces. Also, the tree is weakened mechanically and more liable to be windthrown.

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FIGURE 13.—If the crop is in much danger of burning, at the close of the season each tree is raked in order to give protection. Unburned land makes thriftier trees which yield more gum. Many operators are beginning to work their trees in "rough," or unburned land

(6) Hang the cups as low as possible to prolong the working life of faces.

(7) Chip a moderately narrow face—not more than one-third the circumference of the tree.

(8) Leave at least 4 inches of living wood as bars between the faces on all trees.

(9) If the crop is not well protected from fire, following the season's working rake the ground clean for a distance of 2½ feet on all sides from the base of each worked tree. (Fig. 13.) More and more working is being done under fire protection on "rough" land. This gives more gum and eliminates the expense of raking and burning.

What are some bad turpentining practices?

Unprofitable practices of working timber include: (1) Working too small trees (figs. 14 and 15), (2) chipping too deeply and too wide, (3) placing too many faces on trees, and (4) leaving insufficient width in bars between faces.

It is difficult for private owners and operators to break away from the custom of cupping very small trees and overcupping large ones. In their desire for immediate returns they sacrifice heavily in income, or "kill the goose that lays the golden egg." A case is known where slash-pine trees were cupped at 8 years old and the same trees back cupped seven years later. Frequently all trees are cupped down to 6 or 7 inches in diameter, 2 cups hung on trees down to 9 or 10 inches, and 3 cups hung on trees 13 inches and over by laborers who are paid on the basis of each 1,000 cups hung, or of each "crop" of 10,000 cups. Heavy working is wasteful practice, except for the purpose of clearing up land or thinning heavy stands.

The flow of gum appears to be generally in proportion to the size and vigor of the trees and the size of the face up to the point where the tree is faced too severely. Practical men in the turpentine industry are heard repeatedly expressing the opinion that a large per-

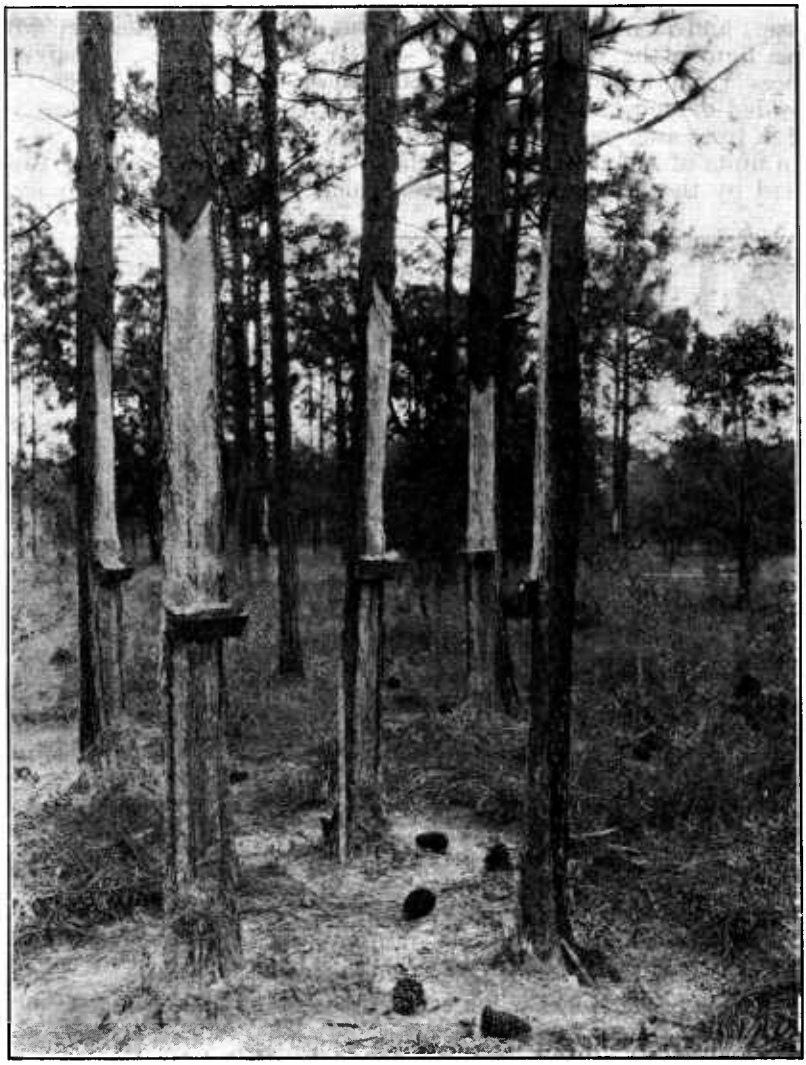

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FIGURE 14.—Bad turpentining is shown. All the trees, including those of all diameters down to 5 inches, are being worked. The faces are deep and the aprons driven deep into the trees

centage of the smaller-sized trees now bled are too small to pay for the cost of operation. The almost complete loss by wind and fire of small trees during or after severe turpentine operations is another potent economic reason for adopting conservative methods.

YIELD OF GUM

How much gum and naval stores will a slash-pine tree yield?

A slash-pine tree, growing in an open stand worked with 32 streaks during the season and scraped, will yield as follows: If 9 inches in diameter (breast height), about 123 ounces; 10 inches, about 140 ounces; and 12 inches in diameter, about 180 ounces. Compare with these figures the yields of trees smaller than 9 inches, namely, 95 ounces from 8-inch trees and 80 ounces from 7-inch trees. In crowded or dense stands small trees run about one-quarter less for 9-inch trees and one-half less for 7-inch trees.

In units of naval stores the yield of slash-pine trees may be illustrated by the average 9-inch tree, which produces a little under 8

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FIGURE 15.—Deep chipping and inserting of aprons often result in serious loss of timber and money returns. Such loss as this by wind and also dry facing are, fortunately, less common now than in the past

pounds (123 ounces) of gum, which will make about one-fifth of a gallon of spirits of turpentine and about 5 pounds of rosin; a 12-inch tree yielding 11.2 pounds of gum will make about one-third of a gallon of spirits of turpentine and about 7 pounds of rosin.

How much naval stores will a crop of slash-pine yield in a season?

There are 10,000 cups in a crop. Varying widely with conditions of size and vigor of trees, as well as the locality and the season, a crop of cups will yield in a full season from 100 to 400 barrels of gum. One dip barrel (50 gallons) of gum commonly yields from 10 to 11 gallons of spirits of turpentine; or it requires nearly 5 barrels of gum to produce 1 barrel (50 gallons) of spirits of turpentine. The size of the tree is an important factor. A crop of average open-grown trees, worked for 5 years with 32 streaks per year, chipped one-half inch deep by one-half inch high, with one face per tree should yield about as follows for different-sized

trees: A crop of 9-inch trees should produce about 42 barrels of spirits of turpentine; 10-inch trees, 49 barrels; 11-inch trees, 55 barrels; and 12-inch trees, 62 barrels. With these trees of regulation sizes, may be compared the amounts of naval stores yielded by crops of undersized trees, namely, 8-inch trees averaging 36 barrels and 7-inch trees averaging only 31 barrels. The latter yields are considered as unprofitable.

The amount of rosin produced at the same time is about 3¼ barrels to 1 barrel of spirits of turpentine. For example, a 50-barrel yield of turpentine at the ratio of 1 to 3¼ means a production of about 162 barrels of rosin. The foregoing indicates the reason why working small trees does not pay expenses.

Another factor, trees grown in dense stands yield about one-quarter less gum for 9-inch trees, one-sixth less for 12-inch, and one-third less for 7-inch trees.

What are some important factors about turpentining and naval stores?

A barrel or cask of spirits of turpentine contains 50 gallons. A gallon weighs about 7¼ pounds.

A barrel of rosin weighs gross about 500 pounds but contains net about 420 pounds of rosin.

About 20 per cent of the weight of the gum or "dip" from the cups is spirits of turpentine. An average of about 9 per cent by weight of the scrape is spirits of turpentine, although there is a wide variation.

The scrape from slash pine trees is relatively small in amount. It is about 6 per cent by weight of the total gum yield of the tree (dip and scrape). In contrast, the scrape from longleaf pine trees, if the cups are raised each year after the first, comprises about 24 per cent of their total product. Otherwise the scrape is relatively larger in amount.

About 40 pounds of dip are required to yield 1 gallon of spirits of turpentine, or about 5 barrels of dip (400 pounds of dip per barrel) to yield 1 barrel of spirits of turpentine. For each barrel of spirits there are produced on an average for the season's run about 3¼ barrels of rosin.

Advanced streaks are of much value in producing larger yields of gum, not only during the early chipping but throughout the season. Four to eight weeks ahead of the first regular streak is recommended as the time to make advance streaks.

Low chipping (that which removes from one-quarter to one-half inch in height by each streak for a season or two may result in less gum, but if continued over a 5-year period results in a larger yield of gum than high chipping through the period. Medium chipping of about one-half to three-quarters of an inch in depth gives the best results in slash pine. Deeper chipping, although for a time giving a higher gum yield, results in greater injury by checking growth and by windfall.

The flow of gum depends closely upon the weather. A hot spell and likewise a hot, rather dry season increase the flow of gum.

The larger the tree the larger the total yield of gum, other conditions being practically alike. Trees measuring under 9 inches in diameter (at 4½ feet above the ground) are doubtful money-makers.

The largest total production of gum from a tree is obtained by working only one face at a time, chipping low and moderately deep, and by nailing instead of driving the tins. The total yield by working two faces at the same time on trees up to 12 inches in diameter is only about 70 per cent as much as that obtained by working only one face at a time. Driving the tins increases dry face, insect attack, and blow down.

On the national forests in Florida turpentining rights are being leased to individuals or companies under the terms of a carefully drawn contract sale. Sample copies of the form used will be mailed upon application to the forest supervisor, United States Forest Service, Pensacola, Fla.

The Department of Agriculture has a number of publications dealing in detail with various phases of turpentining. Application should be made to the Office of Information, United States Department of Agriculture, Washington, D. C.

EFFECTS OF TURPENTINING AND FIRE

Does turpentining affect growth of the tree?

The rate of growth is greatly checked by heavy working. Careful turpentining in accord with conservative methods using one cup per tree generally checks the growth of slash pine trees from one-fourth to one-third of normal. Working two faces usually reduces growth one-half or more of its former rate. Following the working of the tree, a gradual recovery in rate of growth and a natural healing over the face takes place, faster in the more vigorous and healthy topped trees.

Along with the injury resulting from wounding and attendant loss of resin, it appears certain that exposure to fires and the injurious agencies of rot and insect infestation subsequent to turpentining have much to do with any decline in growth that may occur. In case this assumption be correct, it follows that slash pine, if rightly handled, may be turpentined to advantage in advance of the final working and harvesting of lumber.

Does burning affect the yield of turpentine?

A deep layer of straw (leaves), twigs, and dead grass is an effective mulch, conserving much-needed soil moisture and preventing overheating of the soil in midsummer. Under natural conditions the growth of trees thus protected is much faster than where burning occurs frequently. Since the yield of gum depends mostly upon the vigor of the tree, full protection against burning is very profitable. Raking the trees in the fall is a safety measure, and full protection against fire is being effected by an increasing number of operators. Anything which promotes the thrift and vigor of the tree increases the yield of gum. (Fig. 16.) Likewise, during long, hot summers the trees yield more heavily than during cool summers. Burning off the green leaves from young timber under a fire which was hot enough to kill most of the green leaves of pines being turpentined is known to have reduced the yield of gum to one-half that on adjacent unburned trees. (See also pp. 45 to 48.)

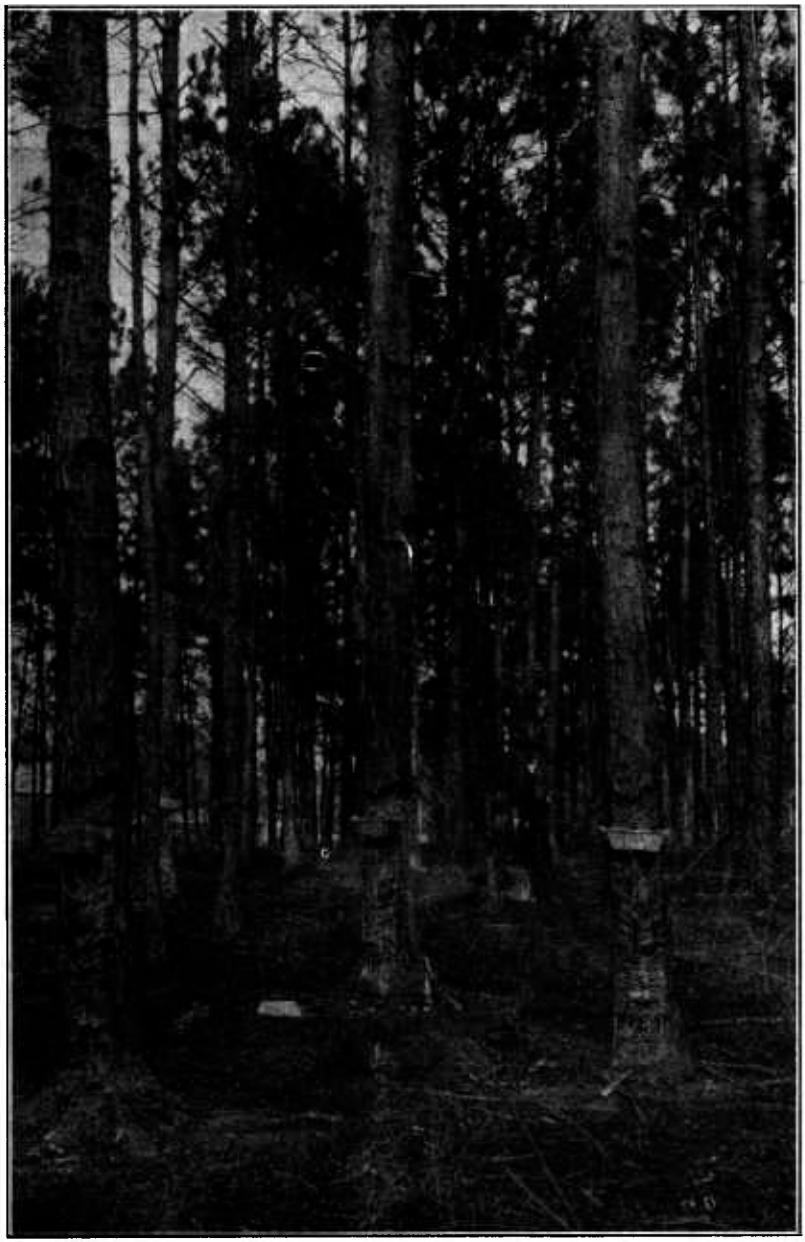

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FIGURE 16.— A profitable stand of slash pine. The farmer has kept out fire, and this 20-year-old stand is being worked continuously for turpentine. The farmer sells the gum to a near-by still

TURPENTINE MANAGEMENT PLAN

In simple terms, the problem of managing a stand of slash pine has as its main object obtaining the largest amount of gum, or crude turpentine, and then cutting the trees for pulpwood lumber or other product. In this connection pine wood is coming to have an increasing use and value for pulpwood.

What are the important steps in handling slash pine as a dual crop?

A stand of young slash pines may be regarded safe from ordinary ground fires when the trees are from 10 to 20 feet in height. Such trees will be from 6 to 12 years old. At this stage the stand may be thinned out so as to save the best trees evenly spaced, and from 200 to 300 per acre.

When the trees have reached heights of 50 to 60 feet, with diameters ranging from 9 to 10 inches, turpentining operations may be begun on all the trees except about 100 of the best developed and thriftiest trees left as evenly spaced as possible to form the final

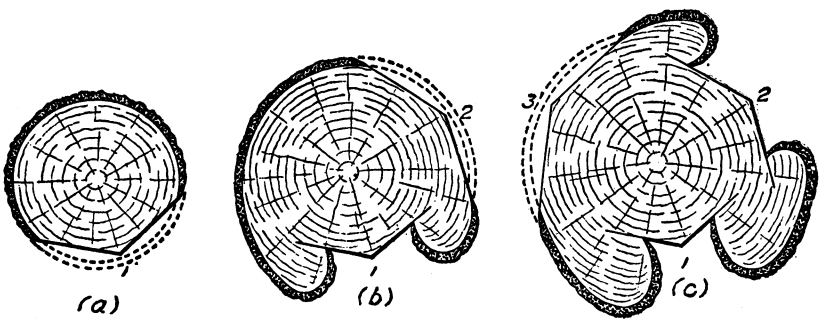

FIGURE 17.—The first working was begun when the tree (*a*) reached 10 inches in diameter (breast height). The second (*b*) was begun after a 3-year working and three years of rest; and the third (*c*) after similar periods of working and rest. Thus, the tree was worked 9 years during a period of 18 years. This method is one of very conservative working, resulting in a good growth of timber and high yield of gum. (The figures 1, 2, and 3 serve to identify the three faces)

timber crop. The trees may be worked for 3 years, rested a year, and back cupped for the next 3 years—making a work period of 7 years. (Fig. 17.) The worked trees may then be cut and utilized for one or another kind of product. The age of the remaining 100 trees will be from 25 to 40 years.

Slash-pine trees or stands, when protected and rightly handled, can be worked for turpentine with rest period from the ages of about 15 to 40 years, or longer. A well-stocked stand will average a growth of 1 to 2 cords of wood per acre per year during the period of from 10 to 40 years, or an equivalent of 300 to 800 board feet per acre yearly.

This brings the owner to the last stage of management, with an option of two courses either of which may be adopted. By one method the trees may all be worked as they grow, conservatively with one face at a time for a period of 6 to 20 years. If the alternative method is adopted, the trees are allowed to grow to a good size for lumber, say 15 to 18 inches, when they are worked heavily with two or more faces per tree, for three or seven years, in the latter

case including a year's rest. If the market is good one or two high workings may be added.

The time required to grow the crop, or the rotation period, as here outlined, will vary from 35 to 50 years, depending mostly upon the conditions of growth and market for the dual product of naval stores and timber.

The exclusion of fire during the life of the stand and the one or more openings of the stand due to cutting the worked trees should result in a good restocking of the land to young slash pines. In the event, however, of a failure in having a sufficient stand of young growth at the time for the final cutting of the mature tree crop, it would be necessary to make some special provision for that purpose. One good way would be to arrange for the cutting during the late fall or winter following the scattering of a full crop of seed or mast.

LEASING TIMBER FOR TURPENTINE

The rights to work trees for turpentine, often called a lease, are sold by timber owners to operators. The time is generally from three to five years, and the prices vary depending upon the market and the size and location of the trees. Prices generally run from 3 to 5 cents per face per year, which for a 4-year lease would range from 12 to 20 cents per face. If the timber is leased on a percentage basis the operator usually pays the timber owner from 15 to 25 per cent of the local value of the turpentine and rosin produced.

Turpentine Leasing Agreement for Farmers

In leasing out turpentine rights to timber it will pay the owner well to do it under a written and signed agreement. Such a contract, in fact, will result in safeguarding the interests of both parties. The essentials of such an agreement, as embodied here in the sample lease and applicable for the use of small owners, are based upon one used by the United States Forest Service in leasing its timber on the national forests. Such money items as the rental charge per face and others which vary locally and from year to year are inserted here merely as illustrations to make the form as clear as possible.

NAVAL STORES AGREEMENT

I, John Doe, of Pine City, State of Florida, hereby agree to work for naval stores certain timber on the lands owned by Richard Roe, Leesville, Fla. Said timber is all the slash and longleaf pine timber not excepted under the terms of this agreement located on an area of about 40 acres to be definitely designated by Richard Roe before cupping begins in section 9, township 4 north, range 6 east, Tallahassee meridian and base line, upon which it is estimated that 2,000 cups, more or less, may be placed. In consideration of the granting of this privilege to me for a term of three years I do hereby promise to pay to Richard Roe the sum of $300, more or less, as may be determined by actual count at the rate of $150 per thousand cups, payable on or before March 15, 1932.

And I further promise and agree to work said timber in strict accordance with the following conditions:

(1) No tree will be cupped, chipped, raked, or worked in any manner until payment has been made in accordance with the terms of this agreement.

(2) Title to the product of the timber included in this agreement will remain in Richard Roe until it has been paid for as herein prescribed and removed from the tree.

(3) No timber will be cupped except that on the area designated by Richard Roe, and all timber on that area will be cupped except as herein specified.

(4) No marked tree and no tree 9 inches or less in diameter at a point 2 feet above the ground will be cupped; not more than 1 cup will be placed on trees from 9 inches to 14 inches, inclusive, in diameter; not more than 2 cups will be placed on trees from 14 inches to 22 inches, inclusive, in diameter; and not more than 3 cups will be placed on any tree.

(5) The greatest depth of streaks will not exceed one-half inch, excluding the bark. The width of the streaks will be so regulated that not more than one-half inch of new wood will be taken off at each chipping. The faces chipped or pulled the first season will not exceed 15 inches in height from the shoulder of the first streak of the season to the shoulder of the last streak of the season, including both. The faces chipped or pulled in subsequent seasons will not exceed 15 inches in height, measured in the same way. A No. 0 hack or puller will be used for chipping or pulling. Bars or strips of bark not less than 4 inches wide in the narrowest place will be left between faces, and this width shall not be lessened as the faces progress up the tree. Where more than one face is placed on a tree, one bar between them will not exceed 8 inches in width. The first streak at the base of the face will be made at the time the apron or gutter is placed. Not more than one streak will be placed on any face during any week. Faces not chipped in accordance with these specifications may be marked out and the cups removed by Richard Roe.

(6) A cupping system satisfactory to Richard Roe will be used, and the cups and aprons or gutters will be so placed that the shoulders of the first streak will be not more than 6 inches distant from the top of the cup, and the cups first placed will be as near the ground as possible. No wood will be exposed on any tree by removing the bark below the gutter or aprons.

(7) No unnecessary damage will be done to cupped trees, marked trees, or to trees below the diameter limit. Trees that are badly damaged during the life of this agreement, when such damage is due to carelessness or negligence, shall be paid for at the rate of $6 per thousand feet board measure, full scale. Trees split or windthrown because of deep incisions for raised tins will be considered as being damaged unnecessarily.

(8) No cups will be placed later than May 15, 1932, without written permission from Richard Roe, and all timber embraced in this agreement will be cupped before said date. The cupping will proceed with all reasonable speed.

(9) Unless extension of time is granted, all timber will be chipped, dipped, and scraped, the product and all cups, aprons, gutters, and nails removed, and each cupped tree thoroughly raked to the satisfaction of Richard Roe not later than December 31, 1934. Tins will be pulled out, not chopped out.

(10) No fires will be set to the timber, underbrush, or grass on the area covered by this agreement without the written permission of Richard Roe, and during the time that this agreement remains in force I will, independently, do all in my power to prevent and suppress unauthorized forest fires on the said area and in its vicinity and will require my employees and contractors to do likewise.

(11) All cupped trees will be raked in a workmanlike manner for the space of 2½ feet around each tree during December of each year of the life of this agreement; and, if required by Richard Roe a fire line not less than 3 feet wide in the narrowest place shall be hoed or plowed around the area covered by this agreement in such a manner as to completely isolate it from adjoining lands. Natural firebreaks, such as creeks, swamps, roads, etc., may be utilized with the consent of Richard Roe. These fire lines must be made and receive the approval of Richard Roe before any cups are placed the first year or new streaks made at the beginning of each subsequent year.

(12) Richard Roe reserves the right to sell or otherwise dispose of and remove or have removed all dead timber and uncupped living timber from the area covered by, and during the life of, this agreement; provided, that the removal of such material will not interfere with the operations of the purchaser.

This agreement will not be assigned in whole or in part without the written approval of Richard Roe.

The conditions of the sale are completely set forth in this agreement, and none of its terms can be varied or modified except in writing with the approval of both parties.

And as a further guarantee of a faithful performance of the conditions of this agreement, I deliver herewith a bond in the sum of $500, and do further agree that all moneys paid under this agreement will, upon failure on my part

to fulfill all and singular the conditions and requirements herein set forth, or made a part hereof, be retained by Richard Roe to be applied as far as may be to the satisfaction of my obligations assumed hereunder.

Signed in duplicate this 20th day of December, 1931.

JOHN DOE,
(Signature of purchaser.)
Operator.
(Title.)

Witnesses (corporate seal, if corporation).
JOHN JONES.
TOM BROWN.

SCALING LOGS AND ESTIMATING TREES

What is a log scale rule?

A scale or rule which shows how many board feet can be cut from logs of various sizes. Most commonly, the diameter of the log in inches is measured inside the bark at the small end, and the length in feet over all.

Does it make any difference what log rule is used for measuring and selling logs?

Yes; a great difference both in the amount of timber and in the resulting money return.

The Doyle rule, although in common use in the South, is unfair to the seller for logs below about 28 inches in diameter. In the early days of large and cheap virgin timber, when narrow and knotty boards were worthless, it was fairly satisfactory, but for scaling small-sized timber, such as second-growth southern pine, it gives such small volumes for small logs as to make it unsatisfactory. On the national forests the Scribner rule (in the decimal C form) is standard. It is more fair than the Doyle rule for small logs, but reasonably careful sawing should result in obtaining from 10 to 20 per cent more lumber than even this rule gives for second-growth timber.

TABLE 2.—*The contents of logs, in board-feet, scaled by the international log rule (using saw cutting ¼-inch kerf)*

Diameter at top end of log inside bark (inches)	Length of log in feet						
	8	10	12	14	16	18	20
	Contents of log in board feet						
6	7	10	13	16	19	23	27
7	12	15	19	24	28	33	39
8	16	21	27	33	39	45	52
9	23	29	36	43	51	59	68
10	29	37	45	54	64	75	86
11	36	46	57	68	80	92	105
12	44	57	70	83	97	111	127
13	52	68	83	100	116	133	151
14	62	80	98	117	136	156	176
15	73	94	114	136	157	180	204
16	84	108	131	156	181	207	233
17	96	123	149	177	205	235	265
18	110	139	169	201	232	265	299
19	123	156	190	225	261	297	335
20	138	174	212	251	290	330	372
21	152	193	234	279	321	366	412
22	168	214	259	307	354	404	453
23	186	235	285	337	388	442	497
24	203	257	311	367	424	481	542

For small timber, such as second-growth pine, the International log rule (Table 2) gives log volumes which are very close to what can be sawed out by using good methods. Careless sawing will give a lower volume of square-edged boards than the logs scaled by this rule, so that it gives the millman a chance to test his own efficiency in this respect. Producers of small logs will benefit when this or some equally close rule has come into general use. The sale of logs by the International rule is recommended.

TABLE 3.—*The contents of logs, in board-feet, scaled by the Doyle log rule*

Diameter at top end of log inside bark (inches)	Length of log in feet						
	8	10	12	14	16	18	20
	Contents of log in board feet						
6	2	2	3	3	4	4	5
7	4	5	7	8	9	10	11
8	8	10	12	14	16	18	20
9	12	16	19	22	25	28	31
10	18	22	27	31	36	40	45
11	24	31	37	43	49	55	61
12	32	40	48	56	64	72	80
13	40	51	61	71	81	91	101
14	50	62	75	87	100	112	125
15	60	76	91	106	121	136	151
16	72	90	108	126	144	162	180
17	84	106	127	148	169	190	211
18	98	122	147	171	196	220	245
19	112	141	169	197	225	253	281
20	128	160	192	224	256	288	320
21	144	181	217	253	289	325	361
22	162	202	243	283	324	364	405
23	180	226	271	316	361	406	451
24	200	250	300	350	400	450	500

As a comparison, a log measuring 10 inches in diameter inside the bark at the small end and 16 feet long, when carefully sawed with a circular saw of ordinary thickness (¼-inch kerf) should, according to the International rule, turn out 64 board feet. For the same log the Doyle rule (Table 3) would show 36 board feet or only about one-half the amount that can be actually sawed and that is credited to it by the International rule.

How are logs scaled?

The diameter of the small end of the log inside the bark is measured in inches, and its length is taken in feet. If a scale stick is used, the contents of the log are read directly from the stick. These readings are for straight and sound logs. Thus the scaling of sound and straight logs is a simple matter. (Fig. 18.) Experience and special knowledge are required to determine the allowance that should be made for defective logs. Slash pine logs average high in freedom from rot.[7]

How many board feet of saw timber can be cut from pine trees of various sizes?

Much depends upon the degree of care exercised, the kind of saw used, and the amounts taken from, and left in, the woods. The

[7] For more information regarding how to scale logs and estimate standing timber consult Farmer's Bulletin 1210, Measuring and Marketing Farm Timber.

International rule (Table 2) shows what can be sawed from logs with a circular saw cutting a ¼-inch kerf, all the usable lumber being taken. This rule, applied to slash pine trees, shows not what is now being cut by wasteful methods but what should be taken to meet the present conditions of scarcity and high price of lumber.

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FIGURE 18.—Logging mature slash pine in the flatwoods of northern Florida. Because of the similarity of the woods, slash pine is cut and marketed without distinction along with longleaf pine. Note the large amount of damage to standing timber by repeated forest fires

To estimate the board-foot contents of a tree, the diameter outside the bark (at breast height, or 4½ feet above the ground) and the number of 16-foot log cuts are ascertained. For example, the contents of a 14-inch tree having three 16-foot cuts is about 129 board feet. (Table 4.)

TABLE 4.—*Saw timber contained in slash-pine trees of various diameters and log lengths if cut and utilized closely. (Cut with circular saw.)*[1]

Diameter of tree at breast height outside bark (inches)	Number of 16-foot logs				
	1	2	3	4	5
	Contents of tree in board feet				
7	18	27	42	-------	-------
8	20	34	52	-------	-------
9	23	39	63	88	-------
10	25	44	76	106	139
11	-------	51	88	125	166
12	-------	57	101	146	192
13	-------	62	115	170	221
14	-------	70	129	187	250
15	-------	76	143	211	282
16	-------	83	160	234	314
17	-------	-------	177	261	348
18	-------	-------	193	287	384
19	-------	-------	212	315	422
20	-------	-------	231	345	463

[1] Logs scaled by the International log rule.

Various kinds of tree-scale sticks, or "cruising" sticks, are coming into use. They are used to measure the diameter and the height, or the number of logs, in a tree. One is known as the Biltmore stick. Some of the sticks also show for trees of different diameters and number of 16-foot cuts, the number of board feet of saw timber than can be cut out. Information as to sources of tree-scale and log-scale sticks and their use can be obtained from your State forestry department, the extension service of your State college of agriculture, or the Forest Service, U. S. Department of Agriculture.

TIMBER PRODUCTION PER ACRE

Many stands of shortleaf pine of known ages have been studied and measured to find out how much timber they will yield per acre. In this the forester deals with fully stocked stands, or those which have no blanks or spots without trees. The quantity of timber is measured in the standing trees, either in cords, crossties, or lumber. With the figures so obtained it is possible to predict the rate of growth and the quantity of timber there should be on an acre at different ages.

How many cords of wood will an acre of slash pine produce?

A fully stocked stand of slash pine 20 years old on poor land should cut out per acre about 20 cords (with the bark on); on average land about 35 cords, and on good land about 46 cords. (Table 5.) The average growth is thus from 1 to 2 cords per acre per year in peeled wood, such as is often wanted for paper pulp and excelsior. It will be seen in Table 5 that an acre of average land will produce slightly more than a cord a year in stands between the ages of 15 and 50 years; also the highest average rate of production of cordwood comes very early when the trees are not older than 15 years.

The number of trees at any given age required to cut a cord can be easily calculated from the last column of Table 1. For example, at 20 years of age on average land, fully stocked slash stands contain about 150 trees per acre. If the stand on average land at that age cuts about 35 cords (column 3 of Table 5), the average tree will cut out about one-fifth of a cord, or it will require about five trees to make a cord.

How much saw timber will an acre of slash pine produce?

The owner or the prospective buyer of timberland should know its capacity for producing timber. Fortunately, the amount of slash pine timber that can be grown per acre can be predicted because of studies which have been made of many well-stocked, well-set, or dense stands. Table 6 shows the amount of saw timber that stands may be expected to cut at various designated ages. The figures do not include the timber removed in previous thinnings, or the intermediate yield, often a very considerable amount. It is regretted that the rate of timber production for unburned stands is not known, as it would be somewhat larger.

TABLE 5.—*Cordwood yield per acre of slash pine at different ages, in well-stocked stands, or about maximum yields* [1]

Age of trees	Wood with bark			Peeled wood		
	Good land	Average land	Poor land	Good land	Average land	Poor land
Years	*Cords*	*Cords*	*Cords*	*Cords*	*Cords*	*Cords*
15	37	27	12	29	20	9
20	46	35	20	35	25	14
25	53	42	26	41	31	18
30	59	48	32	47	37	23
35	66	54	36	53	42	27
40	72	58	40	58	45	30
45	77	62	43	62	49	32
50	81	65	45	66	51	34
55	84	67	47	68	54	36
60	86	69	48	71	56	37

[1] Includes the wood from all trees 4 inches and over in diameter.

An acre of average-grade land well set in slash pines—for example, 30 years old as shown in Table 6, column 3—should cut out an average of 11,800 board feet if all the trees measuring 7 inches and over are carefully sawed. This is an average growth in round figures of 400 feet yearly. If the logs were scaled by the Doyle rule and only the trees that measure 9 inches and over in diameter at breast height were counted, the timber on the acre would scale only about 1,500 board feet. But the scale shown by the Doyle log rule is too low, and the cut would actually be more.

TABLE 6.—*Saw-timber yield per acre in broad feet at different ages from full stocked slash pine stands*

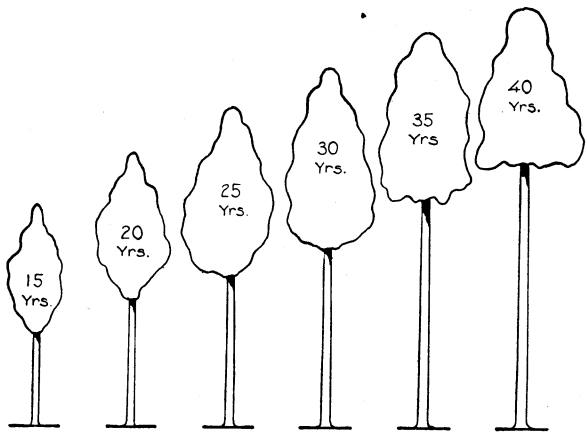
Age of trees	Lumber yield in board feet					
	Actual cut by careful sawing [1] (mill tally)			Logs scaled by the Doyle rule [2]		
	On good land	On average land	On poor land	On good land	On average land	On poor land
Years	*Bd. ft.*	*Bd. ft.*	*Bd. ft.*	*Bd. ft.*	*Bd. ft.*	*Bd. ft.*
15	4,900	1,400				
20	9,500	3,600	450	1,000		
25	15,800	7,200	1,800	3,500		
30	21,700	11,800	3,600	7,000	1,500	
35	26,700	15,800	5,400	11,000	3,500	
40	31,200	19,900	7,700	14,500	6,000	500
45	34,800	23,100	10,000	17,500	8,000	1,500
50	37,100	25,300	11,800	19,500	10,000	2,000
55	39,400	27,600	13,100	21,500	11,500	3,000
60	41,200	29,000	14,500	23,000	12,500	3,500

[1] All trees 7 inches d. b. h. and over, per acre, International ¼-inch saw kerf.
[2] All trees 9 inches d. b. h. and over, per acre, Doyle log rule.

Slash pine, when grown in well-set or dense stands and protected from fire, should grow on the lower grades of land, or situations, 1 cord a year per acre, or from 300 to 500 board feet a year per acre. Such well-set and protected stands on average to good grade lands should grow up to 2 cords an acre yearly, or from 500 to 800 board feet.

At 40 years a fully stocked acre of slash pine (Table 6) on good land should cut about 31,200 board feet, an average of 780 board feet per year; on average land 19,900 feet, or an average growth of about 500 board feet yearly; and on poor land about 7,700 feet, or an average yearly growth of 192 board feet. (Fig. 19.) These illustrate well the wide differences in growth due to different conditions of soil, soil moisture, and climate. Conditions often vary widely in the same locality.

A caution here is advisable. These figures show what would be the yield if all the trees were sound and straight. A slight allowance for seen and unseen defects in the logs is necessary, or the scale will be somewhat too high.



AVERAGE						
HEIGHT OF TREE (feet)	39	48	56	63	69	73
DIAMETER, breast height (inches)	7	8	9½	10½	12	13
BOARD FEET PER TREE	9	20	42	66	105	133
CORDWOOD PER ACRE (with bark)	27	35	42	48	54	58
SAW TIMBER PER ACRE (board feet)	1,400	3,600	7,200	11,800	15,800	19,900

FIGURE 19.—Average size of slash pine trees, their contents in board feet, and the amount of cordwood or lumber per acre at various ages. (See Tables 1, 5, and 6)

What are some examples of stands actually measured?

The following essential facts concerning a few of the stands actually measured will serve as an illustration of what yields per acre may be expected from well-stocked slash-pine stands, such as are locally considered to be dense stands.

(1) A 21-year-old stand, consisting of 384 trees per acre, averaging 8 inches in diameter at breastheight and 56 feet in height, contained 45 cords of wood with the bark on, or 34 cords of peeled wood. If all trees measuring 10 inches and over in diameter were cut, the stand would saw out about 6,400 board feet; or if all trees 8 inches and over were taken, it would saw about 10,300 board feet. By the Doyle log rule, however, all trees measuring 8 inches and up in diameter would scale only 3,700 board feet. This was on good land, giving about maximum yield.

(2) A 25-year-old stand, with 274 trees per acre, averaging 63 feet in height and 9 inches in diameter, contained 47 cords of wood with the bark, or 37 cords of peeled wood. The trees 10 inches and over in diameter would saw out, down to small top diameters, about 10,700

board feet per acre; or about 13,500 feet would be obtained if trees 8 inches and up in diameter were taken. If the logs in the trees measuring 8 inches and over in diameter were scaled by the Doyle rule, there would be only 5,800 board feet per acre.

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FIGURE 20.—Natural regeneration of slash pine: A.—Good stand of slash pine resulting from plenty of seed and protection from fire; B.—Too heavy cutting for pulpwood, leaving no thrifty bushy-topped seed trees to restock the land

(3) A 26-year-old stand, with 754 trees per acre, would cut 64 cords of wood with the bark, or 47 cords of peeled wood. There would be a total of only 1,300 board feet if trees measuring 10 inches

and up were taken; or 8,000 feet from all trees 8 inches and over in diameter, as compared with only 1,360 feet by the Doyle rule.

(4) A 30-year-old stand, with 114 trees per acre, averaging 11 inches in diameter and 69 feet high, contained 31 cords with the bark, or 25 cords of peeled wood. There would be 9,672 board feet per acre of saw timber in the trees 10 inches and over in diameter, or 10,700 board feet in the trees 8 inches and over in diameter. If scaled by the Doyle rule, the stand had only 5,700 board feet.

(5) A 51-year-old stand, which consisted of 220 trees per acre, averaging 70 feet in height and 9.4 inches in diameter, contained 57 cords of wood with the bark, or 44 cords of peeled wood. The stand would cut out 10,100 board feet from all trees 10 inches and over in diameter, or 14,600 feet from trees measuring 8 inches and over. The Doyle rule gave only 5,900 feet of saw timber.

REFORESTATION BY NATURAL METHODS

The natural restocking of slash-pine lands with young growth may be expected to take place satisfactorily whenever sufficient seed trees are left in logging. Young slash pine rapidly takes possession of old fields, wet lands, vacant lands near towns, and on places protected from fire. Such reforestation, however, is not proceeding everywhere on account of carelessness in too heavy cutting and occasional fires. (Fig. 20.)

There are still large areas of practically idle land in the South which should be growing timber. Many owners of small tracts and some owners of large ones are, however, seeking information and are taking active steps toward getting young pine growth to come back on their lands.

Where do the seeds come from?

From the cones, or burs, which mature and open in the fall. Each scale bears two seeds in hollows, or pockets, at its base, which may easily be seen upon examining an open bur. However, scales near the tip and base of the bur commonly do not bear fertile seed. The burs start from very small female flowers that have been fertilized by pollen from the male flowers, and they require two seasons to mature. The pines all bear male and female flowers separately, but both kinds on the same trees.

How much seed do slash pines produce?

Slash pine is a somewhat heavy seed producer. Full or heavy seed crops may be counted on at intervals of two to three years, although some seed is borne almost every year. Well-developed cones, or burs, have been observed on trees 12 years old, but in general trees growing in the open produce seed only after reaching the ages of 15 to 18 years. In close stands seed production is usually limited in quantity and begins at a little later age. The seed is small and provided with a wing by which it is easily carried on moderate winds two or three times the height of the tree for much greater distances. (Fig. 2.) As a result the seed is widely dispersed.

The number of seeds in a pound varies much but averages about 15,500, with approximately 80 fertile seed in every hundred. There are about 215 ripe closed burs in a bushel, which weigh about 34

pounds. A bushel of burs will yield about 1⅕ pounds, or 18,600 seeds, an average of 87 seeds per bur. In size and appearance the seed of slash pine closely resembles that of loblolly pine, with which it is likely to be confused. The wings of slash pine seed are easily removed—more easily than those of any other kind of southern pine.

Can the seed be kept in storage?

Slash-pine seed retains its vitality well in storage. The best-known storage is to place the seed, after thoroughly drying it indoors, in tight containers and keep it at as low a temperature as can be found, preferably in cold storage at a temperature of about 32° to 35° F. If cold storage is not available, the cans or jars might well be kept in a vegetable cellar or pit. The latter storage is satisfactory for seed kept over the first winter; the former should be used to keep seed for use the second spring after collecting.

When and where do the seeds germinate?

Slash-pine seeds, like longleaf, mostly germinate in the fall within a month after they reach the ground. If the seed crop is heavy and the fall rains favorable, as they are at intervals of every few years, full stands of young trees result. Conditions favorable for protection from fire also account for the abundance of slash pine in moist situations and its relative scarcity on dry soils. The broad margins of bodies of water, grass bogs in swamps, and flatlands liable to be water-soaked for some time are favorite situations for slash pine reproduction. Cultivation of abandoned fields disintegrates the underlying hardpan and affords moisture conditions favorable for seed beds. Young slash pine growing on such fields is commonly termed "old-field" pine. Fires, which fortunately are becoming less common and less severe, are still destroying vast numbers of young pines of the different species.

Can slash pine be grown successively as a crop?

With a kind of tree which seeds as abundantly as does slash pine, there is very little difficulty in growing one crop after another on the same land. Two necessary requirements for establishing a young stand are an adequate supply of seed on open ground and protection against fire. Like all the pines, the best production of slash pine comes from having even-aged trees in fairly close stands.

If a stand of pine trees is cut clean there will be little or no young growth, except where the trees are cut in the fall after the ripening of a good crop of seed. Since logging usually breaks up the surface soil the ideal time to cut the final crop or stand of trees would be during the two or three weeks while the ripened burs are opening in early fall. This would be just ahead of the period of seed germination and establishment of the young tender seedlings. Reference might well be made to the subject as found on page 35.

PLANTING SLASH PINES

The absence of seed-bearing trees sometimes makes it necessary to start young forest growth by means of so-called artificial reforestation. This is merely getting a stand of trees started either by

transplanting small trees or sowing the seed on the land. Slash pine is well adapted for reforesting lands by either method, but more especially by the planting of young seedlings. Young slash pines have small taproots and stand transplanting well if ordinary

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FIGURE 21.—Reforesting land by sowing pine seed: A.—Slash pine seed were sown here in 1-year rough grass on wet "crawfish" land in the coastal plain of South Carolina; B.—12 years later the slash pines were 30 feet in height and 5 to 6 inches in diameter at breast height. The stand now needs thinning and the trees can be used profitably. The arrow identifies the same stump in both pictures

care is taken, as shown later. Slash pine is apparently capable of being extended to a considerable distance beyond the limits of its present natural range.

Is direct seeding of land advisable?

Only under special conditions. In wet or "crawfish" land in the coastal plain of South Carolina and Georgia, satisfactory results have been obtained by direct sowing of slash pine seed. Early November sowings have proved more successful than those made in late March or early April. Sowings made with about 2 pounds of seed broadcast in 1-year rough grass, on low, poorly drained lands have given satisfactory stands (fig. 21); also fair stands have resulted from sowing 1 to 1½ pounds of seed, in hoed spots with 10 seeds to the spot and 1,000 spots per acre. A fairly open stand of grass acts as a protection against sun and wind in affording moisture in the air and modifying extremes of temperature. Pine seed should never be covered more than very slightly.

In seed-spotting low wet land a good method is to scatter 8 to 10 seeds on loose soil and press them in with the foot without any, or a slight, scattering of soil over them. Owners of recently abandoned pieces of farm land can expect satisfactory results from broadcasting 1 to 2 pounds of slash pine seed in the late fall and harrowing them in like a grain crop.

However, the seed-sowing method is regarded generally as uncertain and less satisfactory than the planting of small tree seedlings. If successful as to germination, the method requires considerable labor in thinning out the excess seedlings in order to secure a stand of uniform density. If a dry period follows the sowing, germination may be so delayed as to result in a loss of the seed by insects, mice, or birds. This result has been reported as prevailing in the lower parts of the States bordering the Gulf of Mexico.

Direct seeding of slash pine might well be tried on a small scale or experimentally on wet flatlands or low old fields by landowners interested in securing another crop of trees.

Is the planting of small trees a good method of reforesting land?

Yes; it is in general practice in the coastal plain—the home of slash pine. Slash pine is one of the easiest of all the pines to grow from seed and set out much like setting cabbage or tobacco plants. Successful and extensive plantations of 1-year-old seedlings have been made in the coastal plain of South Carolina, Georgia, Florida, and Louisiana. In the latter State one lumber company has more than 12,500 acres of hand-planted young slash pine forest.

HOW TO GET PINE SEEDLINGS

How can slash-pine seedlings be obtained?

Small year-old seedlings of slash pine can sometimes be found and dug up in old fields near mature seed trees, grown in a nursery bed at home, or purchased at nominal cost from the State forestry departments of the various States. Seedlings that have grown in sod or tight soil have poor root development and generally give unsatisfactory results. If the acreage to be planted is large, it will likely pay to establish a local nursery and grow the trees. In any case it is advisable to write to the State forester of your State forestry department, or apply to the local county agent for advice and publications on how to get a supply of seedlings, and

how to plant them. Applications for seedling trees should be made to the State forester several months in advance of midwinter or early spring—the best times for planting. Your county agent is in a position to assist you in all phases of timber growing as a crop on the farm, as he is in touch with the State extension forester. There are State or United States Department of Agriculture publications on nearly every phase of reforestation available free upon request to your State forestry agencies, or to the Forest Service, Department of Agriculture, Washington, D. C.

Where can one get slash-pine seed?

Pine seed may be collected from the trees, or purchased from some of the State agricultural colleges or from commercial seedsmen. It is usually an advantage to plant seed grown in the locality or near-by region. Information about crops of slash pine seed will be found on pages 32 and 33.

The seeds begin to ripen and the burs turn brown in early fall. After the burs have turned one-half brown, the collection should begin and may be continued up to the time the burs open. This is a period of three to five weeks. Pine seed is most economically obtained from tops of trees felled in logging. The burs should be pulled off and collected in gunny sacks, buckets, or tubs, and later spread out to dry on a tight floor or on canvas or sacking in the sun. In drying weather they will open in a few days, and if stirred or shaken the seeds will fall out. Each seed has a wing, and the mass of seed should be winged by rubbing over a screen or between the hands and then winnowed in a steady gentle breeze or in a grain fanning mill. Seed with the wings on are unsatisfactory for direct seeding or use in nursery beds.

Commercial prices of seed range mostly from $5 to $7 per pound. In good seed years, supplies of seed may be collected and cleaned at a cost of not more than $2 per pound, if logging operations are under way so that burs can be picked off the tops of trees felled in logging. If the trees have to be climbed for gathering the burs, the cost may go up to $3 or more per pound. Often the burs can be had by paying collectors from $0.75 to $1.25 per bushel, depending upon the abundance and ease of collecting. Following the tropical hurricane of early October, 1928, burs were obtainable in abundance for 50 to 75 cents per bushel. A bushel generally yields from 1 to 1¼ pounds of good seed. Occasionally, in dry years, pine seeds do not fill out well and are of poor quality.

How can one grow pine seedlings?

Of the various types of nursery beds one form is well adapted to slash pine. It consists of an ordinary bed, flat or even with the paths, or slightly raised and bordered by a curbing of 1 by 4 inch boards set 2 inches in the ground, thus holding in the soil. A width of 4 feet is standard for pine-seed beds. (Fig. 22.) A sandy type of soil is much better than clay soils.

The soil should be worked well in the fall and again in the spring. Acid soils are very desirable, as damping-off fungi are common and thrive in alkaline or sweet soils. On farms the beds should preferably be located near the house, so as to be easily watched and tended, and a supply of water for use during extra dry spells is desirable,

especially during seed germination. All large nurseries must have adequate watering systems.

In early spring slash-pine seed should be sown evenly in well-prepared beds at the rate of a pound (about 15,500 seeds) to each

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FIGURE 22.—Growing slash pine seedlings in nursery beds: A.—One-year-old trees in Georgia State nursery ready for planting. A full stand has about 50 seedlings per square foot. B.—Small farm nursery bed of yearling seedlings in northern Florida, being viewed by interested visitors

4 by 20 foot bed. The seeding should be broadcast or, if preferred, in drills spaced 3 inches apart. The purpose is to produce a crop of about 75 thrifty seedlings per square foot, or 6,000 per bed 4 by

20 feet in dimension. Losses may be expected due to infertile seed, fungi, and insects.

After being sown the seeds are pressed into the soil by a roller, plank, or spade, and then covered very lightly with sand and a single layer of burlap (gunny sack) or by a medium layer of fine woods litter. The material should be as free as possible of weed seed. Silt or sand from stream banks is well suited for use in nursery beds.

How should nursery beds be protected and cared for?

The sown beds should be watched closely, carefully protected, and watered in case of hot dry weather. The period during the germination of the seed is especially critical, when an adequate supply of water will often mean the difference between success and failure. If a burlap cover is used, it should be removed as soon as the seeds begin to germinate, as the seedlings rise in the seed shells much as do those of cucumbers and watermelons.

Birds, mice, and insects are likely to be pests. A shotgun, traps, and poison are means of fighting these enemies. The period of germination of slash seed is usually two weeks or less, so that expensive wire-screened frames over the seed beds are not regarded as necessary. Shading by screens also is unnecessary in a slash-pine nursery. Ants sometimes cause much damage. A simple poison as bait can be used. Moles sometimes cause trouble and may be kept out by encircling the bed with a narrow trench filled with lime, or by sinking a strip of half-inch wire mesh to a depth of 1 foot around the bed. The damping-off fungi are likely to attack the tender stems just below the surface when the seedlings are up to 2 weeks old. Better ventilation and drying of the surface soil is helpful. Acid soils are the best for pine nurseries, therefore never apply lime as a deterrent to this class of injurious fungi.

For further information on fighting any pests of the nursery, application should be made to your local State forester or to the United States Department of Agriculture, Washington, D. C.

All weeds should from the start be pulled out when small, otherwise weeding will greatly injure the small pines. Watering during hot dry spells is very advisable. A dense stand of seedlings such as should be growing in the beds require much soil moisture. A gentle but thorough watering at intervals is much better than a mere surface wetting every day, and requires less time.

HOW TO PLANT PINE SEEDLINGS

When is the best time to plant pine seedlings?

In the early spring before the buds begin to swell the conditions are most favorable for planting slash pine seedlings. Late fall planting may give good results if the season happens to be wet and the winter mild, but much injury may be expected during a dry fall and during a severe winter, because of hard freezing and the resulting upheaval of the soil. If planted in the late spring after the new growth has started, pine seedlings are likely to make a poor growth or die during dry weather.

What are the important steps before planting pine seedlings?

One-season-old slash pine seedlings are best for planting. At the end of one growing season they should be from 8 to 10 inches in height—sometimes higher.

FIGURE 23.—A slash pine nursery of a Louisiana lumber company: A.—Digging, or lifting 1-season-old slash pine seedlings. The soil is carefully loosened and the trees lifted without injuring the roots. B.—The roots and stems are wrapped in wet sphagnum moss or in burlap, and the bundles are placed in crates for delivery at the planting places. In this nursery of a large Louisiana lumber company 7,000,000 slash pine seedlings were grown

The seedlings should be carefully dug and lifted from the nursery bed in order to avoid as fully as possible breaking the fine rootlets.

(Fig. 23, A.) All underdeveloped seedlings should be thrown away as culls, since it is an expensive mistake to plant spindling or sickly small trees. The taproot, if over 8 inches long, should be pruned back with a sharp knife. It is of the utmost importance that the roots at all times be kept wet; hence the dug seedlings should at once be placed in tubs or buckets with water, or wrapped in wet moss or gunny sack. (Fig. 23, B.) If not wanted at once for planting, the seedlings should be heeled in, in fresh soil, always in a cool, shaded place, and the soil never allowed to dry out. The leaves should be left freely exposed to the air but not to direct sunlight.

Some preparation of the soil for planting is often helpful. If the land is rough with stumps or bushes, the trees may be planted without soil preparation. A good method in open ground with heavy grass is to run furrows to break up the soil and mark off the land. The trees are then set in the furrow at regular intervals.

In planting slash pines with the purpose mainly of producing a turpentine orchard a wider spacing should be used than in planting

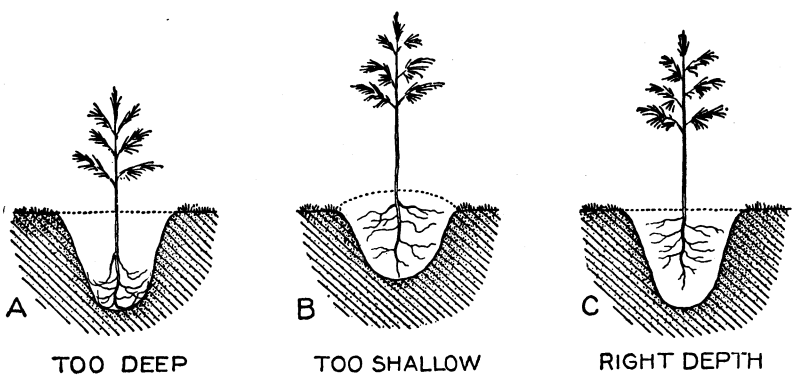

FIGURE 24.—The seedling trees should be set a little deeper than they grew in the nursery or woods as shown in C. Doubling up the taproot as in A is extremely injurious and if set too high, as in B, the tree is likely to fall over in a wind or dry out and die

for the largest possible crop of timber. A common practice now in the South is to plant seedlings about 5½ feet apart in rows or furrows spaced 8 feet, requiring 1,000 trees per acre. If every alternate tree is cut later in a thinning (perhaps at an age of 10 to 15 years) a stand of 500 trees is left. On small areas on farms this spacing seems favorable. In planting large areas a wider spacing is usually made. Trees planted every 8 feet in rows or furrows spaced 8 feet apart give a favorable stand of 680 trees per acre. A method described on page 43, that is being used in old fields in south Georgia with heavy growth of broom sedge, spaces the trees 5 feet apart in rows 10 feet apart, forming a stand of 870 trees per acre. This gives a driveway between rows for use in later turpentining operations when it is planned to work and cut out every other tree in the furrow.

How should pine seedlings be planted?

The essential aim of good planting is to get the trees firmly set in the ground, a little lower than they stood in the nursery, with

the least possible injury to the fine rootlets. (Fig. 24.) The roots must always be kept moist during planting and spread out in the hole or slit rather than bunched. Afterwards the soil should be well firmed about the tree to avoid rapid drying of the soil. From an economic point of view it is desirable to use some relatively inexpensive method. Two kinds of tools for making the planting holes are in use, namely, the mattock, or small grub hoe, and a special tool known as a dibble.

A good method of planting small pines is for two men to work together as a crew—one making the holes and one carrying a bucket

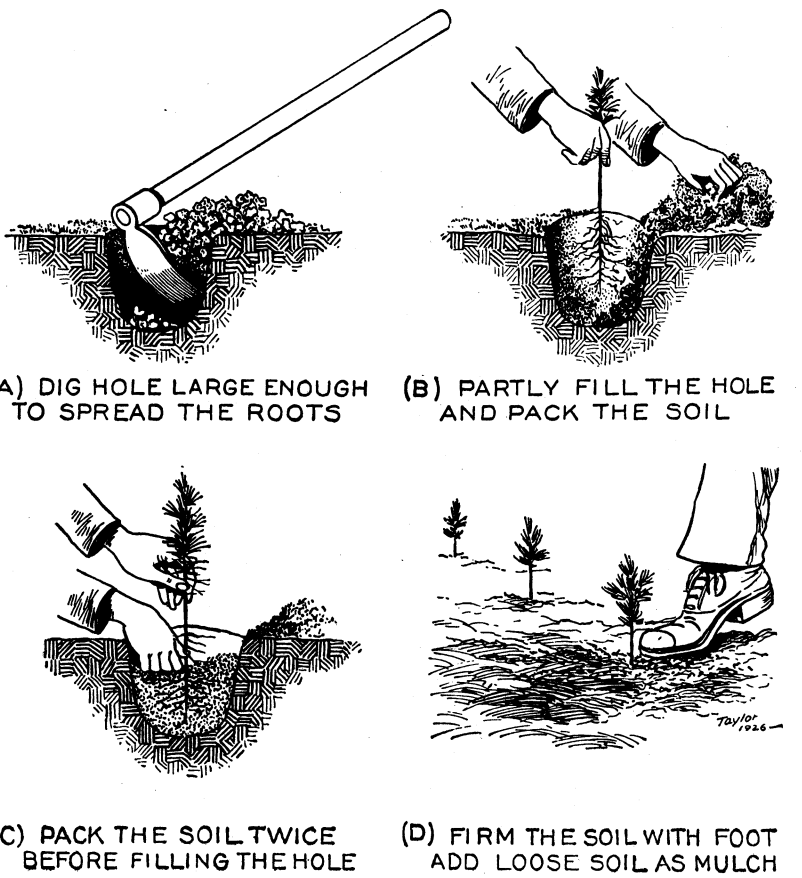

FIGURE 25.—How to plant pine seedlings with a mattock or grub hoe in land that is not furrowed. Trees may also be planted in this manner in the bottom of furrows in soil that is not loose or not easily windblown

of trees and planting them. The bucket should have water or better a clay puddle. A two-man crew using a mattock in average sandy soil can plant 1,000 to 1,200 trees a day, or using a dibble and under good organization of the work, from 1,200 to 2,000 trees. In using the mattock the holes are often dug larger than is necessary. They should be dug, as shown in Figure 25, only a little larger than is needed to spread out the roots in a natural position, with the tap-

root straight down. The soil is then scraped in about the tree, which should be set a little deeper than it grew in the nursery bed or woods, and well firmed with the foot (sole or heel of shoe) so as to prevent drying out. Some straw, grass, or loose soil scraped

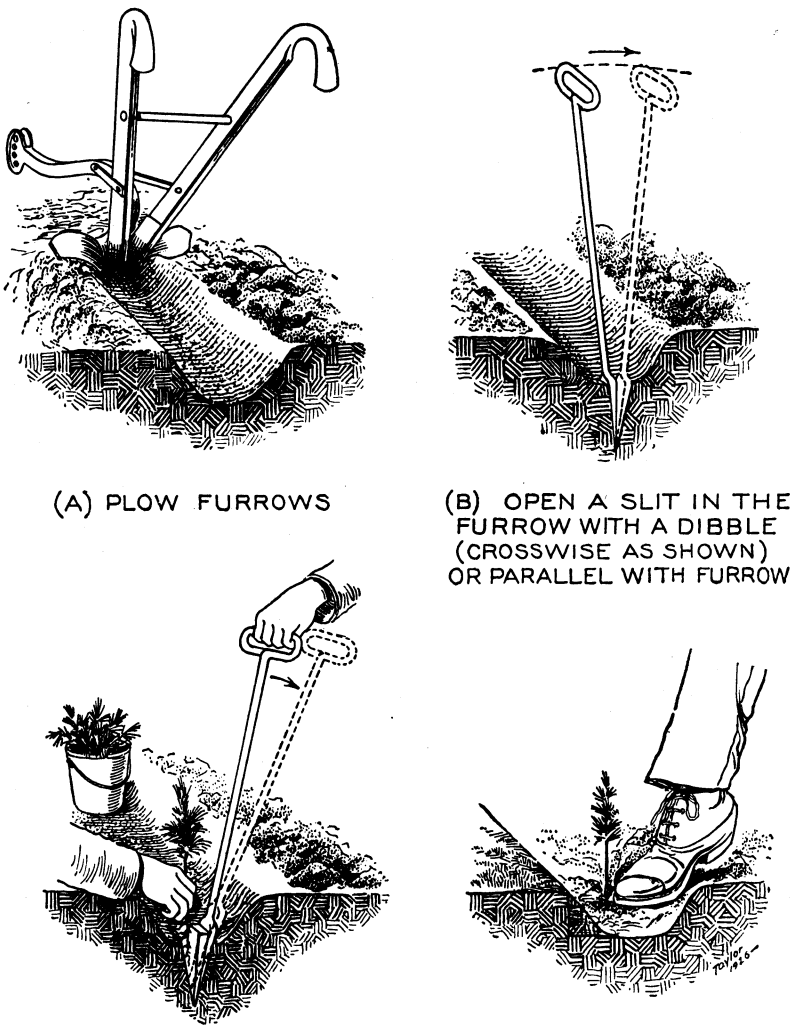

FIGURE 26.—How to plant small pines, using a dibble. This is a rapid method applicable in sandy soils, and requires two men or a man and a boy. One uses the dibble, and the other carries a bucket of seedlings and holds one at a time in the slits. The dibble method is often used without furrowing the soil, especially where the grass cover is not heavy

about the tree will be helpful in acting as a mulch against rapid drying.

In loose, open soil the dibble may be used to good advantage, as shown in Figure 26. It is a straight, thin blade of iron on a handle

(fig. 27) and is used to open a slit and to close it after the little tree has been set in the slit.

In loose soil two men or a man and a boy should set an average of more than twice as many as by using a mattock in firm soil. In old fields and with thin grass, furrowing may not afford any advantage

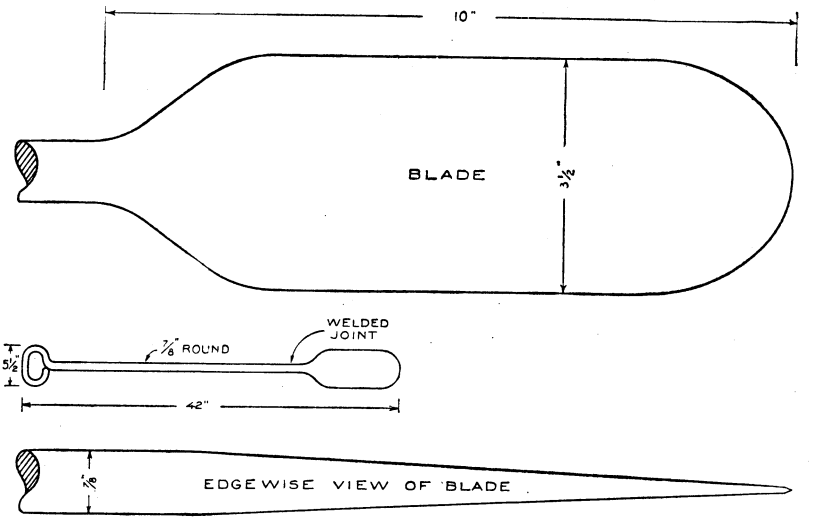

FIGURE 27.—A good tool for planting small forest trees is the dibble. The blade is of steel, 3½ by 10 inches, and tapers in thickness as shown from ⅞-inch down to an edge. The handle is of ⅞-inch iron and welded to the blade. Various forms of dibble are for sale at hardware stores

or not enough to justify its expense. In the sandy lands of southern Georgia, with a cover of heavy broom sedge, a method of planting slash pines has been developed that promises good success. Figure 28 illustrates the method. A furrow is first made with a 4-inch scooter plow (or Harney stock plow). Next two broad furrows are turned

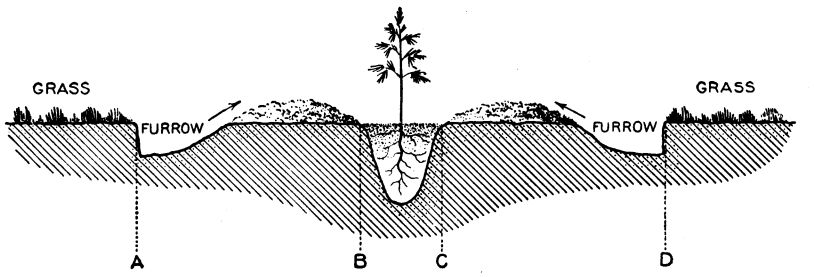

FIGURE 28.—Method of planting pine seedlings in heavy grass land by double-furrow preparation. Center furrow run with a 4-inch scooter plow, and two furrows made with a turning plow. This method checks competition from weeds and grass and conserves soil moisture. Distances: A to D, 3 to 4 feet; B to C, 6 to 8 inches. (See fig. 29)

inward, one on each side, throwing the sod so as to nearly meet over the scooter furrow. This forms a catch basin for rain water and checks the growth of competing grass on each side and affords a good degree of fire protection. The appearance of such bedded or listed land is shown in Figure 29.

In the planting the trees were set 5 feet apart in furrows 10 feet apart, or 870 per acre. The purpose was to turpentine and thin out each alternate tree as soon as possible, leaving a stand of 436 trees,

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FIGURE 29.—Methods of planting slash pines: A.—A scooter-plow furrow followed by two ordinary furrows on the sides affords a very good planting ground, especially in heavy broom-sedge fields. The competition from weeds and grass is checked and the danger from fire greatly reduced. B.—Group of agricultural high-school boys planting poor sandy land on the school farm with slash pine seedlings. The trees were planted by mattocks or spades 6 by 6 feet apart, making a stand of 1,210 per acre. A good spacing on small tracts of land such as about farms

spaced 10 by 10 feet apart, for future development and working. The 10-foot lanes afforded driveways for the removal of turpentine and timber.

Advantage should be taken of favorable weather. Cloudy weather following rains affords ideal conditions. After planting no further attention is necessary, except protecting the trees at all times from fire and hogs or other injurious livestock.

No livestock should be permitted to run over land set in pines for at least the first five years. Watering and cultivating the trees in a forest plantation are both impracticable from a financial standpoint and should not be attempted. The case is different where a few trees are set out for ornamental purposes.

In a forest plantation the loss up to 15 per cent of the total number of trees set out is not an uncommon experience. Among the common causes are the poor grade of trees used, careless planting, and drought at the time of planting or soon after. If any considerable loss occurs, it is good practice to reset the blank places the next spring or a year later. The importance of fire protection is discussed below.

COST OF PLANTING PER ACRE

In estimating the cost per acre of planting pine seedlings, much depends upon the size of the operation and the kind of soil and its condition. Experience shows that some people have found it cheaper to dig wild seedlings, while many more landowners have found it much better and cheaper in the long run to plant only thrifty nursery-grown stock because of its better root development. Such trees may be grown at home, or, in most States, they may be purchased from the State forestry commission. Assuming a cost of $3 per thousand for nursery-grown seedlings, 680 seedlings per acre (a spacing of 8 by 8 feet apart) will cost $2.05. With 20 cents for furrowing and $1.25 for a third of a day with two laborers in planting the trees, the items amount to a total of $3.50 per acre, which is believed to be conservative.

With spare hands and teams in winter the farmer may be able to figure on a somewhat lower cost. Probably the planting of 1,000 seedlings per acre (5½ by 8 feet) can be done at a total cost of $5 with the possibility of lessening the cost by items of cheap labor and teams. Planting cut-over land on a large scale, one lumber concern in Louisiana has planted more than 16,000 acres of slash pines at an average cost of about $4 per acre, including all expense items. (Fig. 30.)

PROTECTION OF THE TREE CROP

Is woods burning harmful?

The damage and loss to slash pine caused by fire is enormous and ranks along with that caused by heavy and wasteful cupping. Both these causes of injury are man-made and of all the sources of injury can be most readily controlled.

The yearly burning of the woods, still practiced in some parts of the natural home of slash pine, has been done with little realization of the enormous damage to the timber and forest land and of the money loss to the owner.

If southern pinelands have seed trees and are protected from fire, young growth will generally spring up in sufficient abundance for a new crop. Young pines that are afforded protection from fire grow

rapidly and create wealth. Protection of the cut-over lands from fires (fig. 31) would mean in a relatively short time the turning of millions of acres of idle lands into profitable growing crops of turpentine and timber.

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FIGURE 30.—Two hand-planted forests of slash pines. A.—A 1,000-acre hand-planted forest of slash pine in Louisiana. The trees are 5 years old and 8 to 12 feet in height. Fire has been excluded, resulting in a cover of broom-sedge grass up to 4 feet in height. The owners have planted over 16,000 acres with slash pines. B.—Five-year-old slash pines planted as year-old seedlings on an old field in south Georgia. The trees are spaced 8 feet apart, or 680 per acre. Some rough cultivation has been given to check rank weed growth

Fire protection, while very desirable throughout the life of slash pine, is particularly so during the first three to five years of the life

of seedlings. The rapid growth soon takes the sapling above the hottest fire zone, which occurs just above the dense grass. In this respect slash closely resembles loblolly pine but differs widely from

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FIGURE 31.—Fire is a serious menace to young pines. A.—A fire burning at night was stopped by this woods road which is covered with carpet grass, closely grazed. All young trees on the left were killed. Across the road is a full stand of thrifty sapling slash pines. The practice is increasing of establishing carpet grass in fire breaks for grazing as a means of better protection. B.—Two furrows thrown together make a cheap and effective fire break in the wire-grass country for stopping a slow fire or for use in back-firing. A disk plow and tractor are used

longleaf pine. Although trees that have attained heights of 3 to 6 feet are injured and sometimes destroyed by slow or " cool " fires, yet

a sufficient number of trees generally remain for the growth of a fair stand. Stands of pine which have not passed through repeated fires are fortunately becoming more numerous in the South.

Fire damages and weakens mature trees, making them easy prey for insects and wood-rotting fungous diseases or so-called "punks." Trees weakened by fire are easily windthrown, and this causes the loss of large amounts of pine timber. (Fig. 15.) Millions of young pine trees, the foundation of the future forest income, are killed yearly by fire. Other millions of young saplings are defoliated and otherwise injured, resulting in stunted growth. The period of growth to reach merchantable sizes is thus lengthened and the financial returns decreased.

The leaves, or "straw," from pines contain considerable nitrogen and small amounts of phosphoric acid and potash. A ton might contain these essential fertilizing elements to the value of $2 to $4. An unburned pine woods may have as much as 10 to 15 tons of leaves and other organic matter. All this humus or woods mold has additional value as a mulch in preventing heating and drying of the soil and thus adds to the health and vigor of growth of the trees.

Pine timber grows rapidly when the trees are given enough growing space and are kept from harm by fire. (See pp. 9 and 13.)

Timber often pays all the farm taxes—grow it as a crop.

What damage is caused by insects?

Outbreaks of the southern pine beetle occur occasionally, but nearly always during years of extreme drought or locally in places where little rain has fallen for two or three months of the growing season. It is important that close watch of pine stands be kept during unusually dry periods. The adult is a small dark-brown beetle. In the soft inner bark of the tree it lays eggs which hatch into grubs, often known as "worms." These feed on the rich, living layer of inner bark and new wood, thus girdling the tree and causing its death. The life history of this insect is known, and information regarding measures for checking its depredations can be obtained from State entomologists, or from the Bureau of Entomology and Plant Quarantine, United States Department of Agriculture, Washington, D. C.

The pine sawyer is a large beetle whose larva, a white grub, bores into the sapwood of dead or felled timber. Its activity may be checked by peeling and drying the timber or immersing it in water.

Young slash pine seedlings are only occasionally injured by the Nantucket tip moth, which attacks the tender young shoots in the early summer. It is rare to find the shoots killed by this or any other insect. If so attacked, the tree becomes somewhat deformed, and its rate of growth is slowed up. Most trees successfully outgrow the attack.

Are pine trees subject to diseases?

If uninjured by fire or other agencies, slash pine, until an advanced age, is not seriously affected by "red heart" or other fungous diseases. Wounds caused by fire admit the spores or "seeds" of fungi, but as a rule the vigorous young trees are able to combat them successfully. Probably the antiseptic qualities of the crude

turpentine, or gum, help in this matter. After the tree reaches an advanced age red heart is likely to become an enemy, sometimes eating away the heartwood and thus weakening the tree, as well as destroying the value of the affected wood. The best protection is to keep out all fires, and cut and utilize trees as soon as they show the "bumps," which are good indications of the presence of disease.

PROFITS FROM SLASH PINE STANDS

The financial returns from second-growth pine on the farm or small holding are not difficult to determine if fire, the chief source of damage and loss, is absent. Under fire prevention or control the lands naturally restock without expense, and the timber growth is

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FIGURE 32.—Slash pine ranks as the fastest-growing pine in the South up to about 20 years of age. On old fields its growth is often extremely fast. At 13 years of age this stand is being worked for turpentine with 104 trees per acre, bringing the owner $10.40 per acre. In addition there were 524 trees per acre left for future working. This stand represents about the maximum rate of growth and yield of products for the age

rapid. A very favorable situation on many farms is that second-growth pine from 20 to 40 feet in height already occurs, sometimes covering a considerable part of the farm. If the timber is slash pine, it will be merchantable for turpentine, ties, pulpwood, and firewood at ages of from 20 to 30 years, yielding from 12 to 60 cords of wood per acre. (Fig. 32.) Older stands, from 30 to 40 years of age, yield saw timber at the rate of 7,000 to 18,000 board feet per acre. Thus slash pine affords a choice of two sources of revenue. The value of young growth is being realized more and more as utilization includes smaller and smaller sizes of timber. Under these conditions, obviously, only a comparatively few years are required for rapid-growing kinds of trees to become merchantable.

Open-grown slash pine, on average situations, may be expected to produce in 40 years a merchantable log 40 feet long, measuring 10 inches at the top by 18 inches at the butt, and containing 270 board feet of lumber.

Slash pine grows rapidly in dense stands and, at from 15 to 25 years of age, yields large amounts of crude turpentine. Concrete examples of well-stocked stands of young growth, after making liberal deductions for taxes and fire-protection costs during the period, show profits of from 8 to 12 per cent compound interest on an investment of $5 an acre.

Land of average quality in slash pine may be expected to yield continuously a net revenue from crude turpentine or gum of from 50 cents to $1.50 an acre and an equal amount from the timber growth, or a combined yearly net return of from $1 to $3 an acre.

Crude turpentine, or gum, usually sold in the standing tree, has long been looked upon in the South as a standard farm product. In many sections of the South farmers are cupping their timber and selling the gum to the local stills. After trees reach 9 to 10 inches in diameter, cupping them for turpentine is extensively practiced. For closely grown slash pine stands this size corresponds to ages between 20 to 30 years on good soils and 35 to 50 years on unfavorable situations. Open-grown trees reach this size at ages of from 15 to 25 years. Many farmers and other small timber owners have derived a good profit from selling the turpentine rights to operators of stills for 15 to 20 cents a face or cup for a period of three years' working. In 1919 the prices advanced from 15 cents a cup on average private timber to a peak price of 25 cents on timber in the Florida National Forest. When carefully turpentined for a period of from 6 to 15 years or more, including resting intervals, and then turned into rough wood products or lumber, slash pine can be handled on short rotation or at an early age with good profit.

The demand for timber to be used in making ties, poles, excelsior blocks, and stave wood indicates good markets hereafter for small-sized timber. New paper mills, each requiring from 100 to 500 cords of wood daily, are being established in the South in regions not already fully covered by similar mills. The pulpwood in many instances is drawn from locations 100 miles from the mill. Lumber of smaller and poorer grades is being used each year in increasing amounts. These factors point toward the profitable growing of crops of slash pine with resulting benefit to the landowner, the community, and the State.

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FIGURE 33.—Slash pine in its virgin haunts. In the original forest, slash pine was confined to poorly drained flat lands, but since the cutting of the virgin forests it has spread widely over much of the region formerly dominated by longleaf pine

There is plenty of land on farms for growing timber as a crop after all the better lands are used for other farm crops and for pastures.

No farmer can afford to pay taxes on idle land. Forest conservation on the farm has come to be a matter of economic necessity.

Forests, unlike many natural resources, can be used and regrown forever. Continuous production of tree crops on lands best suited for the purpose is the aim of forestry.

Since timber and wood are required for the successful operation of the farm, and since most farmers have some lands best adapted to tree growth, the growing of timber as a crop is legitimately a part of the farm program.

FURTHER INFORMATION

The State foresters at the various State capitals and the State extension foresters at the various State colleges of agriculture are in a position to furnish further information, especially regarding slash pine in their respective States. Farmers should consult their local agricultural county agents who are now dealing with forest trees as a farm crop. These agents are in close touch with the State extension forester and have for distribution various publications on the subject of tree farming. Requests may also be addressed to the Forest Service, United States Department of Agriculture, Washington, D. C.

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